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THE STUDY OF SOCIOLOGY.

By HERBERT SPENCER.

I.—Our Need of It.

OVER his pipe in the village ale-house, the laborer says very positively what Parliament should do about the "foot and mouth disease." At the farmer's market-table his master makes the glasses jingle as, with his fist, he emphasizes the assertion that he did not get half enough compensation for his slaughtered beasts during the cattle-plague. These are not hesitating opinions. On a matter affecting the agricultural interest, it is still as it was during the Anti-Corn-Law agitation, when, in every rural circle, you heard that the nation would be ruined if the lightly-taxed foreigner was allowed to compete in our markets with the heavily-taxed Englishman: a proposition held to be so self-evident that dissent from it implied either stupidity or knavery.

Now, as then, may be daily heard, among other classes, opinions just as decided and just as unwarranted. By men called educated, the old plea for extravagant expenditure, that "it is good for trade," is still continually urged with full belief in its sufficiency. Scarcely any decrease is observable in the fallacy that whatever gives employment is beneficial—no regard being had to the value for ulterior purposes of that which the labor produces; no question being asked what would have resulted had the capital which paid for the labor taken some other channel and paid for some other labor. Neither criticism nor explanation appreciably modifies these beliefs. When there is again an opening for them, they are expressed with undiminished confidence. Along with these delusions go whole families of others. People who think that the relations between expenditure and production are so simple, naturally assume simplicity in other relations among social phenomena. Is there distress somewhere? They suppose nothing more is required than to subscribe money for

relieving it. On the one hand, they never trace the reactive effects which charitable donations work on bank-accounts, on the surplus capital bankers have to lend, on the productive activity which the capital now abstracted would have set up, on the number of laborers who would have received wages and who now go without wages; they do not perceive that certain necessaries of life have been withheld from one man who would have exchanged useful work for them, and given to another who perhaps persistently evades working. Nor, on the other hand, do they look beyond the immediate mitigation of misery; but deliberately shut their eyes to the fact that as fast as you increase the provision for those who live without labor, so fast do you increase the number of those who live without labor; and that, with an ever-increasing distribution of alms, there comes an ever-increasing outcry for more alms. Similarly throughout all their political thinking. Proximate causes and proximate results are alone contemplated; and there is scarcely any consciousness that the original causes are often numerous and widely different from the apparent cause, and that beyond each immediate result there will be multitudinous remote results, most of them quite incalculable.

Minds in which the conceptions of social actions are thus rudimentary, are also minds ready to harbor wild hopes of benefits to be achieved by administrative agencies. In each such mind there seems to be the unexpressed postulate that every evil in a society admits of cure; and that the cure lies within the reach of law. "Why is not there a better inspection of the mercantile marine?" asked a correspondent of the *Times* the other day; apparently forgetting that within the preceding twelve months the power he invoked had lost two of its own vessels, and barely saved a third. "Ugly buildings are eyesores, and should not be allowed," urges one who is anxious for æsthetic culture; and, meanwhile, from the agent which is to foster good taste, there have come monuments and public buildings of which the less said the better, and its chosen design for the Law-Courts incurs almost universal condemnation. "Why did those in authority allow such defective sanitary arrangements?" was everywhere asked, after the fevers at Lord Londesborough's; and this question you heard repeated, regardless of the fact that sanitary arrangements, having such results in this and other cases, were themselves the outcome of appointed sanitary administrations—regardless of the fact that the authorized system had itself been the means of introducing foul gases into houses.[1] "The State should purchase the railways," is confident-

[1] Of various testimonies to this, one of the most striking was that given by Mr. Charles Mayo, M. B., of New College, Oxford, who, having had to examine the drainage of Windsor, found that, "in a previous visitation of typhoid fever, the poorest and lowest part of the town had entirely escaped, while the epidemic had been very fatal in good houses. The difference was this, that, while the better houses were all connected with the sewers, the poor part of the town had no drains, but made use of cesspools in the gardens. And this is by no means an isolated instance."

ly asserted by those who, every morning, read of chaos at the Admiralty, or cross-purposes in the dock-yards, or wretched army organization, or diplomatic bungling that endangers peace, or frustration of justice by technicalities and costs and delays—all without having their confidence in officialism shaken. "Building Acts should insure better ventilation in small houses," says one who either never knew or has forgotten that, after Messrs. Reid & Barry had spent £200,000 in failing to ventilate the Houses of Parliament, the First Commissioner of Works proposed that "the House should get some competent engineer, above suspicion of partiality, to let them see what ought to be done."[1] And similarly there are continually cropping out in the press, and at meetings, and in conversations, such notions as that the State might provide "cheap capital" by some financial sleight of hand; that "there ought to be bread-overseers appointed by Government;"[2] that "it is the duty of Government to provide a suitable national asylum for the reception of all illegitimate children."[3] And here it is doubtless thought by some, as it is in France by M. de Lagevenais, that Government, by supplying good music, should exclude the bad, such as that of Offenbach.[4] We smile on reading of that French princess, celebrated for her innocent wonder that people should starve when there was so simple a remedy. But why should we smile? A great part of the current political thought evinces notions of practicability not much more rational.

That connections among social phenomena should be so little understood need not surprise us, if we note the ideas which prevail respecting the connections among much simpler phenomena. Minds left ignorant of physical causation are unlikely to appreciate clearly, if at all, that causation, so much more subtle and complex, which runs through the actions of incorporated men. In almost every house, servants, and those who employ them, alike believe that a poker leaned up in front of the bars, or across them, makes the fire burn; and you will be told, very positively, that experience proves the efficacy of the device—the experience being that the poker has been repeatedly so placed and the fire has repeatedly burned; and no comparison having been made with cases in which the poker was absent, and all other conditions as before. In the same circles the old prejudice against sitting down thirteen to dinner still survives: there actually exists, among ladies who have been at finishing-schools of the highest character, and among some gentlemen who pass as intelligent, the conviction that adding or subtracting one, from a number of people who eat together, will affect the fates of some among them. And this state

[1] Debates, *Times*, February 12, 1852.
[2] Letter in *Daily News*, November 28, 1851.
[3] Recommendation of a Coroner's Jury, *Times*, March 26, 1850.
[4] *Revue des Deux Mondes*, February 15, 1872.

of mind is again displayed at the card-table, by the opinion that So-and-so is always lucky or unlucky—that influences are at work which, on the average, determine more good cards to one person than to another. Clearly, those, in whom the consciousness of causation in these simple cases is so vague, may be expected to have the wildest notions of social causation. Whoever even entertains the supposition that a poker put across the fire can make it burn, proves himself to have neither a qualitative nor a quantitative idea of physical causation; and if, during his life, his experiences of material objects and actions have failed to give him an idea so accessible and so simple, it is not likely that they have given him ideas of the qualitative and quantitative relations of cause and effect holding throughout society. Hence, there is nothing to exclude irrational interpretations and disproportioned hopes.

Where other superstitions flourish, political superstitions will take root. A consciousness in which there lives the idea that spilling salt will be followed by some evil, obviously allied as it is to the consciousness of the savage filled with belief in omens and charms, gives a home to other beliefs like those of the savage. It may not have faith in the potency of medicine-bags and idols, and may even wonder how any being can reverence a thing shaped with his own hands; and yet it readily entertains subtler forms of the same feelings. For, in those whose modes of thought we have been contemplating, there is a tacit supposition that a government moulded by themselves has some efficiency beyond that naturally possessed by a certain group of citizens subsidized by the rest of the citizens. True, if you ask them, they may not deliberately assert that a legislative and administrative apparatus can exert power, either mental or material, beyond the power proceeding from the nation itself. They are compelled to admit, when cross-examined, that the energies moving a governmental machine are energies which would cease were citizens to cease working and furnishing the supplies. But, nevertheless, their projects imply an unexpressed belief in some store of force that is not measured by taxes. When there arises the question—Why does not Government do this for us? there is not the accompanying thought—Why does not Government put its hands in our pockets, and, with the proceeds, pay officials to do this, instead of leaving us to do it ourselves; but the accompanying thought is—Why does not Government, out of its inexhaustible resources, yield us this benefit?

Such modes of political thinking, then, naturally go along with such conceptions of physical phenomena as are current. Just as the perpetual-motion schemer hopes, by a cunning arrangement of parts, to get from one end of his machine more energy than he puts in at the other; so the ordinary political schemer is convinced that out of a legislative apparatus, properly devised and worked with due dexterity, may be had beneficial State-action without some corresponding detri-

mental reaction. He expects to get out of a stupid people the effects of intelligence, and to evolve from inferior citizens superior conduct.

But, while the prevalence of crude political opinions, among those whose conceptions about simple matters are so crude, might be anticipated, it is somewhat surprising that the class specially disciplined by scientific culture should bring to the interpretation of social phenomena methods but little in advance of those used by others. Now that the transformation and equivalence of forces is seen by men of science to hold not only throughout all inorganic actions, but throughout all organic actions; now that even mental changes are recognized as the correlatives of cerebral changes, which also conform to this principle; and now that there must be admitted the corollary that all actions going on in a society are measured by certain antecedent energies, which disappear in effecting them, while they themselves become actual or potential energies, from which subsequent actions arise; it is strange that there should not have arisen the consciousness that these highest phenomena are to be studied as lower phenomena have been studied—not, of course, after the same physical methods, but in pursuance of the same principles. And yet scientific men rarely display such a consciousness.

A mathematician, who had agreed or disagreed with the view of Prof. Tait respecting the value of Quaternions for pursuing researches in Physics, would listen with raised eyebrows were one without mathematical culture to express a decided opinion on the matter. Or, if the subject discussed was the doctrine of Helmholtz, that hypothetical beings, occupying space of two dimensions, might be so conditioned that the axioms of our geometry would prove untrue, the mathematician would marvel if an affirmation or a negation came from a man who knew no more of the properties of space than is to be gained by daily converse with things around, and no more of the principles of reasoning than the course of business taught him. And yet, were we to take members of the Mathematical Society, who, having severally devoted themselves to the laws of quantitative relations, know that, simple as these are intrinsically, a life's study is required for the full comprehension of them—were we to ask each of these his opinion on some point of social policy, the readiness with which he answered would seem to imply that in these cases, where the factors of the phenomenon are so numerous and so much involved, a general survey of men and things gives data for trustworthy judgment.

Or, to contrast more fully the mode of reaching a conclusion which the man of science uses in his own department, with that which he regards as satisfactory in the department of politics, let us take a case from a concrete science—say, the question, What are the solar spots, and what constitution of the Sun is implied by them? Of tentative answers to this question there is first Wilson's, adopted by Sir William

Herschel, that the visible surface of the Sun is a luminous envelope, within which there are cloudy envelopes covering a dark central body; and that, when by some disturbance the luminous envelope is broken through, portions of the cloudy envelope and of the dark central body become visible as the penumbra and umbra respectively. This hypothesis, at one time received with favor mainly because it seemed to permit that teleological interpretation which required that the Sun should be habitable, accounted tolerably well for certain of the appearances—more especially the appearance of concavity which the spots have when near the limb of the Sun. But, though Sir John Herschel supported his father's hypothesis, pointing out that cyclonic action would account for local dispersions of the photosphere, there has of late years become more and more manifest the fatal objection that the genesis of light and heat remained unexplained, and that no supposition of auroral discharges did more than remove the difficulty a step back; since, unless light and heat could be perpetually generated out of nothing, there must be a store of force perpetually being expended in producing them.

A counter-hypothesis, following naturally from the hypothesis of nebular origin, is that the mass of the Sun must be incandescent; that its incandescence has been produced, and is maintained, by progressing aggregation of its once widely-diffused matter; and that surrounding its molten surface there is an atmosphere of metallic gases continually rising, condensing to form the visible photosphere, and thence precipitating. What, in this case, are the solar spots? Kirchhoff, proceeding upon the hypothesis just indicated, which had been set forth before he made his discoveries by the aid of the spectroscope, contended that the solar spots are simply clouds, formed of these condensed metallic gases, so large as to be relatively opaque; and he endeavored to account for their changing forms as the Sun's rotation carries them away, in correspondence with this view. But the appearances as known to observers are quite irreconcilable with the belief that the spots are simply drifting clouds. Do these appearances, then, conform to the supposition of M. Faye, that the photosphere encloses matter which is wholly gaseous and non-luminous; and that the spots are produced when occasional up-rushes from the interior burst through the photosphere? This supposition, while it may be held to account for certain traits of the spots, and to be justified by the observed fact that there *are* up-rushes of gas, presents difficulties not readily disposed of. It does not explain the manifest rotation of many spots; and, indeed, it does not seem really to account for that darkness which constitutes them spots; since a non-luminous gaseous nucleus would be permeable by light from the remoter side of the photosphere, and hence holes through the near side of the photosphere would not look dark.

There is, however, another hypothesis which more nearly reconciles the facts. Assuming the incandescent molten surface, the ascending

metallic gases, and the formation of a photosphere at that outer limit where the gases condense; accepting the suggestion of Sir John Herschel, so amply supported by evidence, that zones north and south of the Sun's equator are subject to violent cyclones; this hypothesis is, that if a cyclone occurs within the atmosphere of metallic gases between the molten surface and the photosphere, its vortex will become a region of rarefaction, of refrigeration, and therefore of precipitation. There will be formed in it a dense cloud extending far down toward the body of the sun, and obstructing the greater part of the light radiating from below. Here we have an adequate cause for the formation of an opaque vaporous mass—a cause which also accounts for the frequently-observed vortical motion; for the greater blackness of the central part of the umbra; for the formation of a penumbra by the drawing in of the adjacent photosphere; for the elongation of the luminous masses forming the photosphere, and the turning of their longer axes toward the centre of the spot; and for the occasional drifting of them over the spot toward the centre. Still, there is the difficulty that vortical motion is by no means always observable; and it remains to be considered whether its non-visibility in many cases is reconcilable with the hypothesis. At present none of the interpretations can be regarded as established.

Here are sundry suppositions which the man of science severally tests by observations and necessary inferences. In this, as in other cases, he rejects such as unquestionably disagree with unquestionable truths. Continually excluding untenable hypotheses, he waits to decide among the more tenable ones until further evidence discloses further congruities or incongruities. Checking every statement of fact and every conclusion drawn, he keeps his judgment suspended until no anomaly remains unexplained. Not only is he thus careful to shut out all possible error from inadequacy in the number and variety of data, but he is careful to shut out all possible error caused by idiosyncrasy in himself. Though not perhaps in astronomical observations such as those above implied, yet in all astronomical observations where the element of time is important, he makes allowance for the intervals occupied by his nervous actions. To fix the exact moment at which a certain change occurred, his perception of it has to be corrected for the "personal equation." As the speed of the nervous discharge varies, according to the constitution, from thirty to ninety metres per second, and is somewhat greater in summer than in winter; and as, between seeing a change and registering it with the finger, there is an interval which is thus appreciably different in different persons; the particular amount of this error in the particular observer has to be taken into account.

Suppose now, that, to a man of science, thus careful in testing all possible hypotheses and excluding all possible sources of error, we put a sociological question—say, whether some proposed institution will

be beneficial? An answer, and often a very decided one, is forthcoming at once. It is not thought needful, proceeding by deliberate induction, to ascertain what has happened in each nation where an identical institution, or an institution of allied kind, has been established. It is not thought needful to look back in our own history to see whether kindred agencies have done what they were expected to do. It is not thought needful to ask the more general question—how far institutions at large, among all nations and in all times, have justified the theories of those who set them up. Nor is it thought needful to infer, from analogous cases, what is likely to happen if the proposed appliance is not set up—to ascertain, inductively, whether in its absence some equivalent appliance will arise. And still less is it thought needful to inquire what will be the indirect actions and reactions of the proposed organization—how far it will retard other social agencies, and how far it will prevent the spontaneous growth of agencies having like ends. I do not mean that none of these questions are recognized as questions to be asked; but I mean that no attempts are made after a scientific manner to get together materials for answering them. True, some data have been gathered from newspapers, periodicals, foreign correspondence, books of travel; and there have been read sundry histories, which, besides copious accounts of royal misdemeanors, contain minute details of every military campaign, and careful disentanglings of diplomatic trickeries. And on information thus acquired a confident opinion is based.

Most remarkable of all, however, is the fact that no allowance is made for the personal equation. In political observations and judgments, the qualities of the individual, natural and acquired, are by far the most important factors. The bias of education, the bias of class-relationships, the bias of nationality, the political bias, the theological bias—these, added to the constitutional sympathies and antipathies, have much greater influence in determining beliefs on social questions than has the small amount of evidence collected. Yet, though, in his search after a physical truth, the man of science allows for minute errors of perception due to his own nature, he makes no allowance for the enormous errors which his own nature, variously modified and distorted by his conditions of life, is sure to introduce into his perceptions of political truth. Here, where correction for the personal equation is all-essential, it does not occur to him that there is any personal equation to be allowed for.

This immense incongruity between the attitude in which the most disciplined minds approach other orders of natural phenomena, and the attitude in which they approach the phenomena presented by societies, will be best illustrated by a series of antithesis thus: The material media, through which we see things, always more or less falsify the facts: making, for example, the apparent direction of a star slightly

different from its real direction, and sometimes, as when a fish is seen in the water, its apparent place is so far from its real place, that great misconception results unless large allowance is made for refraction; but sociological observations are not thus falsified: through the daily press light comes without any bending of its rays, and in studying past ages it is easy to make allowance for the refraction due to the historic medium.

The motions of gases, though they conform to mechanical laws which are well understood, are nevertheless so involved, that the art of controlling currents of air in a house is not yet mastered; but the waves and currents of feeling running through a society, and the consequent directions and amounts of social activities, may be readily known beforehand.

Though molecules of inorganic substances are very simple, yet prolonged study is required to understand their modes of behavior to one another, and even the most instructed frequently meet with interactions of them producing consequences they never anticipated; but, where the interacting bodies are not molecules but living beings of highly-complex natures, it is easy to foresee all results which will arise. Physical phenomena are so connected that, between seeming probability and actual truth, there is apt to be a wide difference, even where but two bodies are acting: instance the natural supposition that during our northern summer the Earth is nearer to the Sun than during the winter, which is just the reverse of the fact; but among sociological phenomena, where the bodies are so multitudinous, and the forces by which they act on one another so many, and so multiform, and so variable, the probability and the actuality will naturally correspond.

Matter often behaves paradoxically, as when two cold liquids added together become boiling hot, as when the mixing of two clear liquids produces an opaque mud, or as when water immersed in sulphurous acid freezes on a hot iron plate; but what we distinguish as Mind, especially when massed together in the way which causes social action, evolves no paradoxical results—always such results come from it as seem likely to come.

The acceptance of contradictions like these, tacitly implied in the beliefs of the scientifically cultivated, is the more remarkable when we consider how abundant are the proofs that human nature is difficult to manipulate; that methods apparently the most rational disappoint expectation; and that the best results frequently arise from courses which common-sense thinks unpractical. Even individual human nature shows us these startling anomalies. A man of leisure is the man naturally fixed upon, if something has to be done; but your man of leisure cannot find time, and the man to be trusted to do what is wanted, is the man who is already busy. The boy who studies longest will learn the most, and a man will become wise in proportion as he reads much, are propositions which look true but are quite untrue

—as teachers are nowadays finding out in the one case, and as Hobbes long ago found out in the other. How obvious it appears that, when minds go deranged, there is no remedy but replacing the weak internal control by a strong external control! Yet the "non-restraint system" has had far more success than the system of strait-waistcoats. Dr. Tuke, a physician of much experience in treating the insane, has lately testified that the desire to escape is great when locks and keys are used, but almost disappears when they are disused. And in further evidence of the mischief often done by measures supposed to be curative, here is Dr. Maudsley, also an authority on such questions, speaking of "asylum-made lunatics." Again, is it not clear that the repression of crime will be effectual in proportion as the punishment is severe? Yet the great amelioration in our penal code, initiated by Romilly, has not been followed by increased criminality, but by decreased criminality; and the testimonies of those who have had most experience—Maconochie in Norfolk Island, Dickson in Western Australia, Obermier in Germany, Montesinos in Spain—unite to show that, in proportion as the criminal is left to suffer no other penalty than that of maintaining himself under such restraints only as are needful for social safety, the reformation is great: exceeding, indeed, all anticipation. French school-masters, never questioning the belief that boys can be made to behave well only by rigid discipline and spies to aid in carrying it out, are astonished on visiting England to find how much better boys behave when they are less governed—nay, among English schools themselves, Dr. Arnold has shown that more trust is followed by improved conduct. Similarly with the anomalies of incorporated human nature. We habitually accept the assumption that only by legal restraints are men to be kept from aggressing on their neighbors; and yet there are facts which should lead us to qualify this assumption. So-called debts of honor, for the non-payment of which there is no legal penalty, are held more sacred than debts that can be legally enforced; and on the Stock-Exchange, where only pencil memoranda in the respective note-books of two brokers guarantee the sale and purchase of many thousands, contracts are far safer than those which, in the outside world, are formally registered in signed and sealed parchments.

Multitudes of cases might be accumulated showing how, in other directions, men's thoughts and feelings produce kinds of conduct which, *a priori*, would be judged very improbable. And, if, going beyond our own society and our own time, we observe what has happened among other races, and among the earlier generations of our own race, we meet, at every step, workings-out of human nature utterly unlike those which we assume when making political forecasts. Who, generalizing the experiences of his daily life, would suppose that men, to please their gods, would swing for hours from hooks drawn through the muscles of their backs, or let their nails grow through the palms of their clinched hands, or roll over and over hundreds of miles to

visit a shrine? Who would have thought it possible that a public sentiment and a force of custom might be such that a man should revenge himself on one who insulted him by disembowelling himself, and so forcing the insulter to do the like? Or to take historical cases more nearly concerning ourselves—Who foresaw that the beliefs in purgatory and priestly intercession would cause the lapse of one-third or more of England into the hands of the Church? Or who foresaw that a flaw in the law of mortmain might lead to bequests of large estates consecrated as graveyards? Who could have imagined that robber-kings and bandit-barons, with vassals to match, would, generation after generation, have traversed all Europe through hardships and dangers to risk their lives in getting possession of the reputed burial-place of one whose injunction was to turn the left cheek when the right was smitten? Or who, again, would have anticipated that, when, in Jerusalem, this same teacher disclaimed political aims, and repudiated political instrumentalities, the professed successors of his disciples would by-and-by become rulers dominating over all the kings of Europe? Such a result could be as little foreseen as it could be foreseen that an instrument of torture used by the Jews would give the ground-plans to Christian temples throughout Europe; and as little as it could be foreseen that the process of this torture, recounted in Christian narratives, might come to be mistaken for a Christian institution, as it was by the Malay chief who, being expostulated with for crucifying some rebels, replied that he was following "the English practice," which he read in "their sacred books."[1]

Look where we will at the genesis of social phenomena, and we shall similarly find that, while the particular ends contemplated and arranged for have commonly not been more than temporarily attained, if attained at all, the changes actually brought about have arisen from causes of which the very existence was unknown.

How, indeed, can any man, and how more especially can any man of scientific culture, think special results of special political acts can be calculated, when he contemplates the incalculable complexity of the influences under which each individual, and *a fortiori* each society, develops, lives, and decays? The multiplicity of these factors is illustrated even in the material composition of a man's body. Every one, who watches closely the course of things, must have observed that at a single meal he may take in bread made from Russian wheat, beef from Scotland, potatoes from the midland counties, sugar from the Mauritius, salt from Cheshire, pepper from Jamaica, curry-powder from India, wine from France or Germany, currants from Greece, oranges from Spain, as well as various spices and condiments from other places; and if he considers whence came the draught of water he swallows, tracing it back from the reservoir through the stream and the brook and the rill, to the separate rain-drops which fell wide apart,

[1] Boyle's "Borneo," p. 116.

and these again to the eddying vapors which had been mingling and parting in endless ways as they drifted over the Atlantic, he sees that this single mouthful of water contains molecules which, a little time ago, were dispersed over hundreds of square miles of ocean-swell Similarly tracing back the history of each solid he has eaten, he finds that his body is made up of elements which have lately come from all parts of the Earth's surface.

And what thus holds of the substance of the body, holds no less of the influences, physical and moral, which modify its actions. You break your tooth with a small pebble among the currants, because the industrial organization in Zante is so imperfect. A derangement of your digestion goes back for its cause to the bungling management in a vineyard on the Rhine several years ago; or to the dishonesty of the merchants at Cette, where imitation wines are produced. Because there happened a squabble between a consul and a king in Abyssinia, an increased income-tax obliges you to abridge your autumn holiday; or, because slave-owners in North America try to extend the "peculiar institution" farther west, there results here a party dissension which perhaps entails on you loss of friends. If from these remote causes you turn to causes at home, you find that your doings are controlled by a *plexus* of influences too involved to be traced beyond their first meshes. Your hours of business are predetermined by the general habits of the community, which have been slowly established no one knows how. Your meals have to be taken at intervals which do not suit your health; but under existing social arrangements you must submit. Such intercourse with friends as you can get is at hours and under regulations which everybody adopts, but for which nobody is responsible; and you have to yield to a ceremonial which substitutes trouble for pleasure. Your opinions, political and religious, are ready moulded for you; and, unless your individuality is very decided, your social surroundings will prove too strong for it. Nay, even such an insignificant event as the coming of age of grouse affects your goings and comings throughout life. For has not the dissolution of Parliament direct reference to the 12th of August? and does not the dissolution end the London season? and does not the London season determine the times for business and relaxation, and so affect the making of arrangements throughout the year? If from coexisting influences we turn to influences that have been working through past time, the same general truth becomes still more conspicuous. Ask how it happens that men in England do no work every seventh day, and you have to seek through thousands of past years to find the initial cause. Ask why in England, and still more in Scotland, there is not only a cessation from work, which the creed interdicts, but also a cessation from amusement, which it does not interdict; and for an explanation you must go back to successive waves of ascetic fanaticism in generations long dead. And what thus holds of religious ideas and usages, holds

of all others, political and social. Even the industrial activities are often permanently turned out of their normal directions by social states that passed away many ages ago; as witness what has happened throughout the East, or in Italy, where towns and villages are still perched on hills and eminences chosen for defensive purposes in turbulent times, and where the lives of the inhabitants are now made laborious by having daily to carry themselves and all the necessaries of life from a low level to a high level.

The extreme complexity of social actions, and the transcendent difficulty which hence arises of counting on special results, will be still better seen if we enumerate the factors which determine one simple phenomenon, as the price of a commodity—say, cotton. A manufacturer of calicoes has to decide whether he will increase his stock of raw material at its current price. Before doing this, he must ascertain, as well as he can, the following data: whether the stocks of calico in the hands of manufacturers and wholesalers at home are large or small; whether by recent prices retailers have been led to lay in stocks or not; whether the colonial and foreign markets are glutted or otherwise; and what is now, and is likely to be, the production of calico by foreign manufacturers. Having formed some idea of the probable demand for calico, he has to ask what other manufacturers have done, and are doing, as buyers of cotton—whether they have been waiting for the price to fall, or have been buying in anticipation of a rise. From cotton-brokers' circulars he has to judge what is the state of speculation at Liverpool—whether the stocks there are large or small, and whether many or few cargoes are on their way. The stocks and prices at New Orleans, and other cotton-ports throughout the world, have also to be taken note of; and then there come questions respecting forthcoming crops in the Southern States, in India, in Egypt, and elsewhere. Here are sufficiently numerous factors, but these are by no means all. The consumption of calico, and therefore the consumption of cotton, and therefore the price of cotton, depends in part on the supplies and prices of other textile fabrics. If, as happened during the American Civil War, calico rises in price because its raw material becomes scarce, linen comes into more general use, and so a further rise in price is checked. Woollen fabrics, also, may to some extent compete. And, besides the competition caused by relative prices, there is the competition caused by fashion, which may or may not presently change. Surely the factors are now all enumerated? By no means. There is the estimation of mercantile opinion. The views of buyers and sellers respecting future prices, never more than approximations to the truth, often diverge from it very widely. Waves of opinion, now in excess, now in defect of the fact, rise and fall daily, and larger ones weekly and monthly, tending, every now and then, to run into mania or panic; for it is among men of business as among other men, that they stand hesitating until some one sets the example,

and then rush all one way, like a flock of sheep after a leader. These characteristics in human nature, leading to these perturbations, the far-seeing buyer takes into account—judging how far existing influences have made opinion deviate from the truth, and how far impending influences are likely to do it. Nor has he got to the end of the matter even when he has considered all these things. He has still to ask what are the general mercantile conditions of the country, and what the immediate future of the money market will be; since the course of speculation in every commodity must be affected by the rate of discount. See, then, the enormous complication of causes which determine so simple a thing as the rise or fall of a farthing per pound in cotton some months hence!

If the genesis of social phenomena is so involved in cases like this, where the effect produced has no concrete persistence but very soon dissipates, judge what it must be where there is produced something which continues thereafter to be an increasing agency, capable of self-propagation. Not only has a society, as a whole, a power of growth and development, but each institution set up in it has the like—draws to itself units of the society and nutriment for them, and tends ever to multiply and ramify. Indeed, the instinct of self-preservation in each institution soon becomes dominant over every thing else; and maintains it when it performs some quite other function than that intended, or no function at all. See, for instance, what has come of the "Society of Jesus," Loyola set up; or see what grew out of the company of traders who got a footing on the coast of Hindostan.

To such considerations as these, set down to show the inconsistency of those who think that prevision of social phenomena is possible without much study, though much study is needed for prevision of other phenomena, it will doubtless be replied that time does not allow of systematic inquiry. From the scientific, as from the unscientific, there will come the plea that, in his capacity of citizen, each man has to act; must vote, and must decide before he votes; must conclude, to the best of his ability, on such information as he has.

In this plea there is some truth, mingled with a good deal more that looks like truth. It is a product of that "must-do-something" impulse which is the origin of much mischief, individual and social. An amiable anxiety to undo or neutralize an evil often prompts to rash courses, as you may see in the hurry with which one who has fallen is snatched up by those at hand; just as though there were danger in letting him lie, which there is not, and no danger in incautiously raising him, which there is. Always you find among people, in proportion as they are ignorant, a belief in specifics, and a great confidence in pressing the adoption of them. Has some one a pain in the side, or in the chest, or in the bowels? Then, before any careful inquiry as to its probable cause, there comes an urgent recom-

mendation of a never-failing remedy, joined probably with the remark that, if it does no good, it can do no harm. There still prevails in the average mind a large amount of the fetishistic conception clearly shown by a butler to some friends of mine, who, having been found to drain the half-emptied medicine-bottles, explained that he thought it a pity good physic should be wasted, and that what benefited his master would benefit him. But, as fast as crude conceptions of diseases and remedial measures grow up into Pathology and Therapeutics, we find increasing caution, along with increasing proof that evil is often done instead of good. This contrast is traceable not only as we pass from popular ignorance to professional knowledge, but as we pass from the smaller professional knowledge of early times to the greater professional knowledge of our own. The question with the modern physician is not as with the ancient—shall the treatment be bloodletting? shall cathartics, or shall diaphoretics be given? or shall mercurials be administered? But there rises the previous question—shall there be any treatment beyond a healthy regimen? And even among existing physicians it happens that, in proportion as the judgment is most cultivated, there is the least yielding to the "must-do-something" impulse.

Is it not possible, then—is it not even probable—that this supposed necessity for immediate action, which is put in as an excuse for drawing quick conclusions from few data, is the concomitant of deficient knowledge? Is it not probable that, as in Biology so in Sociology, the accumulation of more facts, the more critical comparison of them, and the drawing of conclusions on scientific methods, will be accompanied by increasing doubt about the benefits to be secured, and increasing fear of the mischiefs which may be worked? Is it not probable that what in the individual organism is improperly, though conveniently, called the *vis medicatrix naturæ*, may be found to have its analogue in the social organism? and will there not very likely come, along with the recognition of this, the consciousness that in both cases the one thing needful is to maintain the conditions under which the natural actions may have fair play? Such a consciousness, to be anticipated from increased knowledge, will diminish the force of this plea for prompt decision after little inquiry; since it will check this tendency to think of a remedial measure as one that may do good and cannot do harm. Nay, more, the study of Sociology, scientifically carried on by tracing back proximate causes to remote ones, and tracing down primary effects to secondary and tertiary effects which multiply as they diffuse, will dissipate the current illusion that social evils admit of radical cures. Given an average defect of nature among the units of a society, and no skilful manipulation of them will prevent that defect from producing its equivalent of bad results. It is possible to change the form of these bad results; it is possible to change the places at which they are

manifested; but it is not possible to get rid of them. The belief, that faulty character can so organize itself socially as to get out of itself a conduct which is not proportionately faulty, is an utterly baseless belief. You may alter the incidence of the mischief, but the amount of it must inevitably be borne somewhere. Very generally it is simply thrust out of one form into another; as when, in Austria, improvident marriages being prevented, there come more numerous illegitimate children; or as when, to mitigate the misery of foundlings, hospitals are provided for them, and there is an increase in the number of infants abandoned; or as when, to insure the stability of houses, a Building Act prescribes a structure which, making small houses unremunerative, prevents due multiplication of them, and so causes overcrowding; or as when a Lodging-House Act forbids this overcrowding, and vagrants have to sleep under the Adelphi-arches, or in the Parks, or even, for warmth's sake, on the dung-heaps in mews. Where the evil does not, as in cases like these, reappear in another place or form, it is necessarily felt in the shape of a diffused privation. For, suppose that by some official instrumentality you actually suppress an evil, instead of thrusting it from one spot into another—suppose you thus successfully deal with a number of such evils by a number of such instrumentalities—do you think these evils have disappeared absolutely? To see that they have not, you have but to ask, Whence comes the official apparatus? What defrays the cost of working it? Who supplies the necessaries of life to its members through all their gradations of rank? There is no other source but the labor of peasants and artisans. When, as in France, the administrative agencies occupy some 600,000 to 700,000 men, who are taken from industrial pursuits, and, with their families, supported in more than average comfort, it becomes clear enough that heavy extra work is entailed on the producing classes. The already-tired laborer has to toil an additional hour; his wife has to help in the fields as well as to suckle her infant; his children are still more scantily fed than they would otherwise be; and, beyond a decreased share of returns from increased labor, there is a diminished time and energy for such small enjoyments as the life, pitiable at the best, permits. How, then, can it be supposed that the evils have been extinguished or escaped? The repressive action has had its corresponding reaction; and, instead of intenser evils here and there, or now and then, you have got an evil that is constant and universal.

When it is thus seen that the evils are not got rid of, but, at best, only redistributed, and that the question in any case is, whether redistribution, even if practicable, is desirable, it will be seen that the "must-do-something" plea is a quite insufficient one. There is ample reason to believe that, in proportion as scientific men carry into this most involved class of phenomena the methods they have successfully adopted with other classes, they will see

that, even less in this class than in other classes, are conclusions to be drawn and action to be taken without prolonged and critical investigation.

Still there will recur the same plea under other forms. "Political conduct must be matter of compromise." "We must adapt our measures to immediate exigencies, and cannot be deterred by remote considerations." "The data for forming scientific judgments are not to be had: most of them are unrecorded, and those which are recorded are difficult to find as well as doubtful when found." "Life is too short, and the demands upon our energies too great, to permit any such elaborate study as seems required. We must, therefore, guide ourselves by common-sense as best we may."

And then, behind the more scientifically-minded who give this answer, there are those who hold, tacitly or overtly, that guidance of the kind indicated is not possible, even after any amount of inquiry. They do not believe in any ascertainable order among social phenomena—there is no such thing as a social science. This proposition we will discuss in the next chapter.

THE RECENT ECLIPSE OF THE SUN.

By R. A. PROCTOR, B. A., F. R. A. S.

THE eclipse of the sun which took place on December 12th last was looked forward to by astronomers with some anxiety, because many months must pass before they will have any similar opportunity of studying the sun's surroundings. Year after year, for four years in succession, there have been total eclipses of the sun—in each year one—and each eclipse has taught us much that has been worth knowing; but during the present year there will be no total solar eclipse worth observing; there will be none in 1873, only one (and not a very important one) in 1874, while during the total eclipse of 1875 the moon's shadow will traverse a path very inconveniently situated for intending observers.

Besides, the inquiries and discussions of astronomers had reached a very interesting stage before the recent eclipse occurred. A sort of contest—though, of course, a friendly and philosophic contest—had been waged over the sun's corona, the halo or glory which is seen around the black disk of the moon when the sun is totally concealed; and, though, in the opinion of most astronomers, the contest had really been decided by the observations made during the total eclipse of December, 1870, some slight doubts still existed in the minds of a few.

It was hoped—and the hope would appear to have been justified—that during the late eclipse these doubts would be finally removed. A few weeks must elapse even after the present paper appears, and five or six from the present time of writing, before the sun-painted pictures, which are to decide the question, can be in the hands of the judges. But, from the description which has already reached us, we can feel very little doubt as to the nature of the decision which will be arrived at.

A brief sketch of the progress of the inquiry into the subject of the solar corona will serve to exhibit the nature of the doubts which the recent expeditions to the Indian seas were intended to remove.

From very early ages it had been known that when the sun's disk is wholly concealed by the moon, a glory of light starts into view, rendering the scene less terrible, though scarcely less striking, than it would be were total darkness to prevail.

Now, gradually, it began to be recognized that this glory around the sun consisted of several distinct portions. In the first place, quite close to the moon's black body, a very narrow ring of light had been observed, so bright that many astronomers were led to believe that the sun was not in reality totally concealed, but that a ring of sunlight remained even at the moment of central eclipse. This excessively bright ring of light is not, however, always seen, if (as many accounts suggest) it is to be distinguished from the bright inner corona of which I shall presently have to speak. During the recent eclipses we have had no clear evidence respecting this brilliant but very narrow ring; and it is just possible that the accounts derived from earlier eclipses have been a little exaggerated.

Then, secondly, a red border is seen around portions of the black disk of the moon. This border has commonly a serrated edge, and has been called the *sierra*, from a well-known Spanish name for a range of hills. From what thus resembles a chain of rose-colored mountains, appear to spring certain red projections which have been called the solar prominences. Their general appearance during eclipse may be inferred from the description given by those who first observed them, in 1842, who compared the moon's disk surrounded by these glowing objects to a black brooch set round with garnets. But it is now known that such names as *prominences* and *protuberances* are not properly applicable to these red objects, and that the word *sierra* is equally inapplicable to the rim of colored light beneath the red projections. The prominences as well as the sierra (for, however unsuitable, the names continue in use) are in reality formed of glowing gas, hydrogen being their chief constituent element, but other elements being also present in a gaseous form. Only, the reader must not run away with the notion that these great red masses, some of which are more than a hundred thousand miles in height, are of the nature of our gas-

flames. They are not, properly speaking, flames at all, but masses of gas glowing with intensity of heat.[1]

Many of the most important discoveries recently made respecting the sun relate to these wonderful objects; but in this place I shall refrain from speaking more about them than seems necessary to illustrate the subject of the corona; for, as a matter of fact, the observers during the late eclipse turned scarcely a thought to the colored prominences, nor is it likely that any thing new respecting them will ever be learned during total eclipses of the sun.

Outside the sierra and the prominences, the true corona is seen. To ordinary vision, and probably also even under the scrutiny of powerful telescopes, it appears to be divided into two distinct portions. There is in the first place an inner and brighter region, extending apparently to a distance from the sun equal to about one-fifth of his diameter. The outline of this inner corona is uneven but not radiated, and, though not sharply defined, appears yet to be very definitely indicated by the rapid falling off of lustre beyond its limits. The inner corona has been described as of a white, pearly lustre by some observers; but under the most favorable conditions it appears, when carefully observed, to have a somewhat ruddy hue.

Extending much farther from the sun, how far is not as yet known, is the radiated corona. It is much fainter than the inner corona, and its light grows fainter and fainter with distance from the sun, until lost to view on the dark but not black background of the sky. Through this faint and softly-graduated corona extend radiations of somewhat greater brightness. It is between these radiations that those dark gaps or rifts appear, which have figured so much in the narratives of recent eclipse observations. The dark gaps are, indeed, more striking features than the radiations which form them; but it must be remembered, nevertheless, that the radiations are the only positive features in this case, the gaps being merely regions where there are no radiations.

We may typically represent the corona, as it had been revealed to us during former eclipses, by the accompanying sketch from a photograph taken by Mr. Brothers at Syracuse during the eclipse of December, 1870. Only, it must be remembered that the photograph may not represent the full extent of the corona, while many details of its structure are too delicate to be shown in a figure so small as is here given. It will be understood further that the inner part, marked R, is much brighter than the whole of the outer part, marked C, and that this outer part shades off gradually into the dark background of the sky.

[1] In a gas-flame there is (as our meters tell us) a continual supply of gas, which mixes with the oxygen of the air, and undergoes what is called combustion. But in the sun's colored prominences the hydrogen enters into no chemical combination, at least none such as we are familiar with. Simply by the intense heat to which it is exposed it glows, just as iron glows when it is heated sufficiently.

Now, the question which has agitated astronomy during the past few years has been simply whether the glory of light seen around the sun is in reality a solar appendage, or may not be due wholly or in part to the illumination either of our own atmosphere or of some other matter (not necessarily atmospheric) lying much nearer to us than the sun does. If we consider the figure, we can see at once that if we have here a real solar appendage—that is, matter which exists all around the sun's globe—it is an appendage of the most amazing extent. The black disk which forms the centre of the figure is of course intended to represent the moon, whose diameter we know is about 2,200 miles, and if for a moment we suppose the corona C and R surrounds the moon, we see that it must extend on one side to about 5,000 miles, and elsewhere to about 2,800 miles. But exactly behind the moon lies the sun, a little more than concealed by the moon; and the sun's diameter is about 850,000 miles. So that, if the corona is something which surrounds the sun, it extends, as the picture shows, to at least 2,000,000 miles on one side, and elsewhere to about 1,200,000 miles. Neglecting the dark rifts for the moment, and regarding the whole corona as shaped like a globe, and having a diameter four times as great as the sun's, we should have to regard its volume as exceeding his *not* four times, nor sixteen times, but sixty-four times. And when we are reminded that the sun's own volume exceeds that of this earth on which we live some 1,200,000 times, we see what a stupendous conclusion we must arrive at, if we regard the corona as a solar appendage. Of course, we need not imagine that the corona has a continuous substance completely filling a space some 77,000,000 times larger than the earth. It may be made up of multitudes of minute bodies, with vacant spaces between. But the conclusion remains that a region of space, exceeding our earth's volume so many millions of times, is thus occupied by matter of some sort.

Nor is the conclusion rendered a whit less surprising if we take the dark rifts into account. Nay, we obtain an enhanced idea of the wonderful nature of the corona, regarded as a solar appendage, when we consider that it possesses so remarkable a structure that, as seen from our distant stand-point, it shows well-defined gaps or rifts. For unquestionably it is not to be regarded as something flat or plane-shaped, like its picture, or a decoration (which in appearance it often strikingly resembles). It must extend *on all sides* from the sun (if it is indeed a solar appendage), and not merely from the sides of the disk he turns toward us at the time of an eclipse; and it can easily be seen that its shape, in length and breadth and thickness, must be strange, to account for such rifts as are shown in the figure. If we take an orange to represent the sun, and, boring holes all over it, stick spills in these holes to represent the region occupied by the corona, we shall find that, in order that our spillikined orange may exhibit a rifted corona in whatever position it is placed, we must either leave several

large parts of its surface without spills, or that the spills over many such parts must be very short. When this consideration is attended to, the spillikin corona will be found to have a very complex and remarkable figure.

It is not to be wondered at that, so soon as the corona began to be thought about at all, astronomers were led to believe that it is not of the nature of a solar appendage, but either a sort of halo in our own atmosphere, or else an appendage belonging in some way to the moon. Kepler and Halley and Newton, to say nothing of a host of other astronomers who considered the question during the infancy of modern astronomy, were led to different conclusions, by the comparatively imperfect evidence available in their day. We may pass over the arguments adduced in favor of the three several theories which were in question. Suffice it that, gradually, it was admitted more and more generally that the corona must be some appendage surrounding the sun; and, in comparatively recent times—a quarter of a centuary ago, or thereabouts—the opinion began to prevail that the corona is in fact the sun's atmosphere.

But quite recently discoveries were made which seemed to throw great doubt upon this opinion. By means of the instrument called the spectroscope, astronomers have learned not only how to study the sun's colored prominences when the sun is shining in full splendor, but also to determine to some extent the condition of the glowing gas of which those prominences are formed. When this was done, it did not appear that the density of the glowing gas—even close by the sun's body —was so great as might be expected if the corona were an atmosphere properly so called. Some prominences are shown in the figure; and if we consider the pressure to which objects so placed must be subjected, supposing them to lie at the bottom of an atmosphere more than a million miles in height, we shall at once see that the pressure of our own air at the sea-level would be a mere nothing by comparison. It is supposed that our air may be two or three hundred miles in depth, but, even if we suppose it to be ten times as deep as this, the depth of the imagined solar atmosphere would be many times greater. And then the pressure of our air is caused by the earth's attraction, and would be greater if the earth exerted a greater attraction. But the attractive energy of the sun (at his surface) exceeds the force of the earth's gravity about twenty-seven times. We may safely infer, then, that an atmosphere such as the corona was supposed to be, would cause a pressure exceeding the atmospheric pressure we experience some thousands of times. The gas forming the prominences would be correspondingly compressed under these circumstances. But as a matter of fact the pressure at the very base of the colored prominences appears to be a mere fraction of that which our own air exerts at the sea-level.

Accordingly, Mr. Lockyer, who had taken a prominent part in es-

tablishing this very interesting result, was led to express the opinion that the sun's atmosphere has no such extent as had been imagined, and that the corona is an appearance (only) in our own air, "an atmospheric effect merely," "due to the passage of the sun's rays through our own atmosphere."

This conclusion was, however, not very generally accepted. Several astronomers at once pointed out that the air which lies toward the place on the heavens where the corona is seen, is not illuminated at all by the sun's rays during total eclipse. I also pointed out that whatever light that particular part of the air receives during totality —not direct sunlight, but light from the prominences, and so much of the corona as might be admitted to be solar—would extend over the very place of the moon, and gradually *increase* thence on all sides instead of gradually diminishing, as happens with the corona. This would not be the place to exhibit the reasoning by which these results can be demonstrated; for mathematical considerations, not altogether simple, are involved in the complete discussion of the matter. Let it suffice to say, as respects the air between the observer and the moon, that, since the observer can see the colored prominences and the inner bright corona during totality, the air all around him (toward the moon as well as elsewhere) must be lit up by their light. And as respects the gradual increase of brightness on all sides of the place where the eclipsed sun is, let the reader consider that, if, at any time during totality, a bird were to fly (with enormous rapidity) from the observer's station directly toward the moon's centre, that bird would remain in the moon's shadow as he so flew; but if he flew in any other direction he would presently pass out of the shadow—that is, he would reach a place where the air is illuminated. And he would so much the more quickly reach the illuminated air, as he flew more directly from the moon's place on the sky. So that, putting the line of the observer's sight instead of the swiftly-flying bird, we see that this line will so much the sooner reach illuminated air, according as it is turned farther from the place of the moon on the heavens. Thus the air toward the place of the moon, though illuminated, is less brightly illuminated than that lying toward any other part of the sky; and the atmospheric illumination must gradually increase the farther we turn our eyes from the moon's place.

So matters stood when preparations were being made for the expeditions to view the eclipse of 1870. Evidence had, indeed, been obtained during the eclipse of 1869 in America, which seemed to show that the substance of the corona is gaseous; and singularly enough it appeared as though this substance, whatever it might be, shone with a light resembling that of the aurora borealis. But those who regarded the corona as a mere glare in our own atmosphere, rejected these results because they seemed "bizarre and perplexing in the extreme." The American astronomers, however, were not willing to have their

observations rejected in this summary fashion; and they, therefore, crossed the Atlantic in great force to observe the Mediterranean eclipse of December, 1870.

It was with some little regret, I must confess, that, as the eclipse of 1870 drew near, I found many of the intending observers proposing to direct their chief attention to the question whether the corona is a solar appendage or a mere glare in our own atmosphere. It seemed to me clear that the atmospheric theory was completely disposed of by the evidence, while a host of interesting questions remained to be answered respecting the nature of the amazing solar appendage thus shown to exist. "I think I have not erred," I wrote in October, 1870, "in insisting that we have ample evidence to prove that the corona is a solar appendage; but what sort of appendage it may be, remains yet to be shown. Observations directed to show whether it is or not a solar appendage will, I apprehend, be a total waste of time; and it is for this reason that I have, at the meetings of the Astronomical Society and elsewhere, deprecated all such observations."—(Preface to second edition of "Other Worlds.") Nay, I fear I even offended one or two by the zeal with which I urged the importance of endeavoring to determine, not whether the corona is a solar appendage, but what sort of solar appendage it may be.

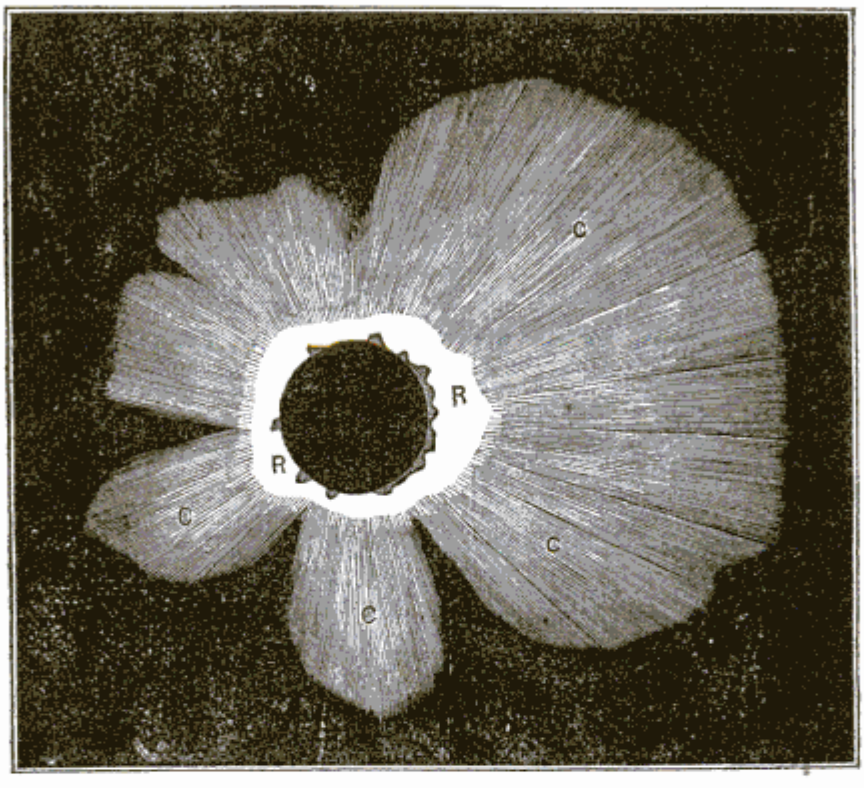
However, the observations were made, photographs and sketches were taken, and the general conclusion drawn from the work of 1870 was that which Sir John Herschel, only six weeks before his lamented decease, enunciated in the following terms in a letter addressed to myself: "The corona is certainly extra-terrestrial and ultra-lunar."

Even then, however, some doubts still remained in a few minds. The question of the corona was still mooted in essays and lectures—nay, the atmospheric theory was so successfully defended before the British Association last August, as to lead Prof. Tait to remark that, in his opinion, it was in the main true; while the president of the meeting—Prof. Thompson—even expressed the opinion that the special observations made last December proved that the greater part of the corona was a mere phenomenon of our own atmosphere. It must be pointed out, however, in justice to these eminent mathematicians, that only one side of the question had been adequately presented to them.

Thus another year had passed, and the subject of the corona stood almost exactly as in the autumn of 1870. Well-appointed expeditions were again about to set forth to view an important eclipse, and again the question which the observers had before them was the worn-out problem whether the corona is or is not a solar appendage.

But much more faith was placed in photography than had been the case in 1870. *Then*, men doubted whether photography *could* give good pictures of the corona. The colored prominences had been photographed repeatedly; but the finest telescopes had failed to bring the

corona fairly on to the glass. Mr. Brothers, of Manchester, however, showed how this difficulty was to be surmounted. He discarded the telescope and employed the ordinary photographic camera. The results were most satisfactory. The eclipsed sun was indeed partially hidden by clouds during all but the last few seconds of totality; but for eight seconds the camera was fairly at work; and the result was, "the corona as it had never been seen on glass before."



THE SUN'S CORONA.
R, the inner or ring-formed corona; C, the outer radiated corona.

During the late eclipse, Mr. Brothers's plan was adopted at several stations, and most successfully, by all the photographing parties whose accounts have yet reached Europe. For many weeks, however, these photographs will not be available for examination. The great point which we know already respecting them is this: that they show an extensive corona, with *persistent* rifts—those taken at the beginning of totality differing from those taken at the end only as respects parts of the corona very far from the sun. All those doubts, which had been based on the circumstance that Mr. Brothers's best photograph was taken nearly at the close of totality, are therefore removed by the photographs taken on the present occasion.

But, the corona was so favorably seen even with the naked eye, during the recent eclipse, as to dispose of all the doubts formerly entertained. In an interesting letter in the *Daily News*, an eye-witness at Bekul, describing Mr. Lockyer's observations, says that so soon as the totality began the corona appeared, *rigid* in the heavens, like a magnificent decoration, suggesting by its fixity the idea of perfect rest

in those distant regions. It was marked with radial streaks of great brilliancy, separated by relatively dark furrows, and extending all round the upper and lower parts of the moon's circumference, but less conspicuous (or altogether wanting—the account is not very clear on this point) at the sides. This observation is of great interest, because the upper and lower parts of the sun's circumference at the moment of observation corresponded to the sun's equatorial regions, while the sides corresponded to the position of the solar poles. Mr. Lockyer's account thus seems to support a theory lately urged, according to which the corona is caused by radial emanations chiefly from the neighborhood of the solar equator. It is clear, however, from the rifts (especially as shown in the figure), that such emanations cannot be continuous, but must take place locally, and, as it were, fitfully.

But the most important account which has yet reached Europe is that contained in a letter from M. Janssen, the eminent spectroscopist, to M. Faye, the president of the French Academy of Sciences. It should be noted, in the first place, that in a letter to the secretary of the Academy Janssen says: "I have just observed the eclipse, only a few moments ago, with an admirable sky; and, while still under the emotion occasioned by the splendid phenomenon which I have but now witnessed, I send you a few lines by the *Bombay Courier*. The result of my observations at Sholoor indicates, without any doubt, the solar region of the corona and the existence of material substances (*matières*) outside the sierra." Then follows his letter to the president, which runs thus: "I have seen the corona as I could not in 1868, when I gave myself wholly to the prominences. Nothing could be more beautiful or more brilliant; and there were definite forms which exclude all possibility of an origin in our own atmosphere." He proceeds to describe the coronal spectrum, confirming the American observations—with one notable exception: he recognized the solar dark lines in the spectrum of the corona, a proof that no inconsiderable portion of its light is reflected sunlight. Then he draws his letter to a conclusion with these decisive words: "I conceive that the question whether the corona is due to our own atmosphere is disposed of (*tranchée*), and we have before us in perspective the study of the regions lying outside the sun, which must needs be most interesting and fruitful." I could wish that the same opinion had been received when it was advocated twenty-two months ago in almost the same words.—*Cassell's Magazine.*

SCIENCE AND IMMORTALITY.

By Rev. T. W. FOWLE.

HE who pretends to have any thing new to say upon so old a subject as the immortality of the soul, must expect to arouse certainly opposition, and probably contempt. Nevertheless, this at least is certain, that the tendency of science, which has powerfully affected every domain of thought in new and unexpected ways, cannot but place the old doctrine of immortality under new and, it may be, unexpected lights, abolishing old arguments, and suggesting new ones that have not yet obtained the consideration they deserve. My object in this paper is to endeavor, by the aid of all-victorious analysis, to throw some little light upon the relations of the belief in immortality with scientific thought; and, at the outset, I wish distinctly and positively to affirm that it is not my intention to construct any argument for the belief against science, but merely to explain the conditions under which, as it seems to me, the question must be debated. Those conditions, though in themselves plain and simple, are, I believe, very imperfectly understood, and much bewildering nonsense is talked upon both sides of the question by men who have not clearly realized the nature of evidence, the amount of proof required, or the sources from which that proof must be derived. I think it possible to lay down a series of propositions with which, in principle at any rate, most reasonable minds would agree, and which would have the effect of defining the area of debate and the true point of conflict. This may sound presumptuous; whether it be really so or not, the event alone can prove.

Now, the first demand of science is for an accurate definition of the object of discussion, that is, that both religious and scientific thinkers should be quite sure that they are discussing the same thing. Immortality is bound up in the minds of religious people with a vast amount of beautiful and endearing associations, which form no part of the hard, dry fact itself. The definition of immortality, viewed scientifically, is, I take it, something of this sort: the existence of a thinking, self-conscious personality after death, that is, after the bodily functions have ceased to operate. This personality may or may not exist forever; it may or may not be responsible for the past; it may or may not be capable of rest, joy, and love; it may or may not be joined to its old body or to a new body. These, and a hundred similar beliefs with which religion has clothed the mere fact of existence after death, form no essential part, I must again affirm, of the fact itself. And throughout the argument, this, and no other than this, will be the sense in which I use the word immortality; because it is the only one that I have a right to expect that the scientific mind will accept.

It may be well, also, before going further, to make it clear to our-

selves in what sense we use the word religion. Men who would be very much ashamed of themselves if they were detected using scientific words inaccurately, do, nevertheless, attribute meanings to the word religion, which it is difficult to hear with patience. I have heard an eminent scientific man upon a public occasion, and in a serious manner, define religion to be duty, making a mere idle play upon the original meaning of the word. Without, however, entering into verbal discussions, it will be, surely, enough to define religion as a practical belief in, and consciousness of, God and immortality; and, as the latter is now absolutely essential to the idea of religion as a motive moral power, and as, moreover, it includes, or at any rate necessitates the belief in the existence of God, we may fairly conclude that, for all practical purposes, and certainly for the purpose of this argument, religion is synonymous with a belief in immortality. And if, for any reason, mankind does at any time cease to believe in its own immortality, then religion will also have ceased to exist as a part of the consciousness of humanity. To clear up, therefore, the relations between immortality and science becomes a matter of the utmost importance. It will be well next to analyze briefly the effect which science has upon the nature of the proofs by which this, like all other facts, must be demonstrated. Let us, for convenience' sake, regard the world as a vast jury, before which the various advocates of many truths, and of still more numerous errors, plead the cause of their respective clients. However much a man may wrap himself up in the consciousness of ascertained truth, and affirm that it makes no matter to him what the many believe, yet Nature is in the long-run too powerful for him, and the instinct of humanity excites him to plead the cause of what he knows to be truth, and to mourn in his heart and be sore vexed if men reject it. Truth is ever generous and hopeful, though at the same time patient and long-suffering; she longs to make converts, but does not deny herself or turn traitress to her convictions if converts refuse to be made. There is a sense, indeed, in which it may be said that truth only becomes actual and vital by becoming subjective through receiving the assent of men. What, then, must the advocate for the fact of the immortality of the soul expect that science will require of him when he pleads before the tribunal of the world for that truth which, because it is dear to himself, he wishes to enforce on others?

The alterations in the minds of men, which the tendency of modern thought has effected in respect of evidence, may be summed up under two heads: First, the nature of the evidence required is altogether altered, and a great many arguments, that would in former days have gone to the jury, are now summarily suppressed. Fact can only be proved by facts, that is, by events, instances, things, which are submitted to experience and observation, and are confirmed by experiment and reason. And, secondly, the minds of the jury are subject to *a priori*, and, on the whole, perfectly reasonable prepossessions before

the trial begins. The existence of changeless law, the regular, natural, and orderly march of life, the numerous cases in which what seemed to be the effect of chance or miracle have been brought within the limits of ascertained causation; all these things predispose the mind against pleadings for the supernatural or the divine. Most true, of course, it is, that there are most powerful prepossessions on the other side as well; but the difference is, that these are as old as man himself, while the former have only been of later times imported into the debate, and, if they have not been originated, have at least received their definite aim and vivid impulse from the results of scientific research.

Now, the first result which flows from these alterations is the somewhat startling one, that all the arguments for immortality derived from natural religion (so called) are, in the estimation of science, absolutely futile. To put this point in the strongest form, all the hopes, wishes, and convictions of all the men that ever lived, could not and cannot convince one single mind that disbelieves in its own immortality. Unless the advocates of religion clearly apprehend this truth, they are, it seems to me, quite disabled from entering into the discussion upon conditions which their opponents, by the very law of this opposition, cannot but demand. It is true, indeed, that this temper of mind is confined at present to a comparatively few persons, as in the last century it belonged to the philosophers and to their immediate followers. But then it is as clear as the day that, as science is getting a more and more practical hold upon men's minds by a thousand avenues, and mastering them by a series of brilliant successes, this temper is rapidly passing from the few into the popular mind; that it is becoming part of the furniture of the human intellect, and is powerfully influencing the very conditions of human nature. Sooner or later we shall have to face a disposition in the minds of men to accept nothing as fact, but what facts can prove, or the senses bear witness to. In vain will witness after witness be called to prove the inalienable prerogative, the intuitional convictions, the universal aspirations, the sentimental longings, the moral necessity, all which have existed in the heart of man since man was. Nor will the science of religion help us in the hour of need. There can be a science of religion exactly as there can be a science of alchemy. All that men have ever thought or believed about the transmutation of metals may be brought together, classified as facts, and form a valuable addition to our knowledge of the history of the human mind, but it would not thereby prove that the transmutation had taken place, or that the desire for it was any thing more than man's childlike strivings after that which could only be really revealed by the methods of natural science. So also the science of religion can prove what men have held, and suggest what they ought to hold. It can show that they have believed certain things to be true, it is utterly powerless to prove that

they are true. It can strengthen the principle of faith in those who do not require positive demonstration for their beliefs; it cannot even cross swords with those, soon to be the majority of thinking men, to whom positive demonstration has become as necessary to their minds as food to their bodies. Nay, they will resent rather than welcome the attempt to put a multitude of hopes and myriads of wishes in the place of one solid fact, and will soon confirm themselves in their opinions, by the obvious argument that these hopes and wishes are peculiar to the childhood of the race, and form only one out of many proofs, that man is liable to perpetual self-deception until he confronts fact and law. Not indeed that they will indulge in the equally unscientific statement that there is no such thing as immortality. The attitude of mind which they will assume will be that of knowing nothing, and of having no reasonable hope of ever discovering any thing, about man's future destiny. And while they will think it good that man, or at any rate that some men, should allow themselves to hope for life after death, yet they will steadily oppose any assertion that these hopes ought to guide men's conduct, influence their motives, or form their character. Now, if this be true, it is difficult to overrate the importance of thoroughly and distinctly realizing it. That the evidence for the truths of natural religion is overwhelming, is one of the statements that are accepted as truisms, at the very moment that science is slowly leavening the human intellect with the conviction that all such evidence is scientifically worthless. Nevertheless the opposite idea has taken firm hold of the religious mind, and forms the basis of many an eloquent refutation of the "presumptuous assurance" and "illogical obstinacy" of modern thought. Men must have smiled to hear themselves alternately refuted and rebuked by controversialists who did not understand the tone of mind against which they were arguing, or who assumed as true the very things which their opponents resolved to know nothing about, either in the way of belief or rejection. It is very certain, however, that this error will not yield to the mere statement that it is an error, and therefore I will go on to examine a little more minutely the various arguments by which men seek to prove the doctrine of immortality These are mainly fourfold:

1. That it is an original intuition, and arising from this,
2. That it is a universal belief.
3. That it follows necessarily from the existence of God.
4. That it is essential as a motive for human morality.

1. I take the statement of this argument from the words of one than whom no man has a better right to be heard on such a subject. Prof. Max Müller, in his preface to the first volume of his "Chips from a German Workshop," writes as follows: "An intuition of God, a sense of human weakness and dependence, a belief in a Divine government of the world, a distinction between good and evil, and a hope of

a better life, these are the radical elements of all religions. . . . Unless they had formed part of the original dowry of the human soul, religion itself would have remained an impossibility." Now, I am not quite sure that I understand in what sense the writer means to assert that these intuitions, which, for practical purposes, may be limited to three, God, sin, and immortality, are part of the original dowry of the human soul. If it is meant that there was a special creation of the human soul, furnished from the beginning with these three intuitions, then science will resolutely refuse to admit the fact. There can be no mistake about the position held by the bulk of scientific men, and little doubt, I should think, as to its reasonableness. If there is any thing that is in ultimate analysis incomprehensible, or any fact that cannot be accounted for by natural causes, then the possibility of special creation and original intuitions must be candidly allowed, but not otherwise. There is just a chance, for instance, that the difference between the brains of the lowest man and the highest animal may ultimately be regarded as a fact inexplicable upon any theory of evolution; more, however, from a lack of evidence than from any other cause. Be this as it may, the possibility of special creation finds a distinct foothold in the acknowledged fact that the connection between thought and the brain of animals, as well as of man, is an ultimate incomprehensibility, a mystery which the law of man's intelligence prevents his ever even attempting or hoping to understand. The famous saying "*cogito ergo sum*," the foundation of all modern metaphysics, may come to be a formula under which religion, philosophy, and science, may all take shelter, and approach each other without ever actually meeting.

But the three intuitions of God, sin, and immortality, can all be accounted for by the growth of human experience, as every one knows who has at all studied the subject. At some period of the world's history, science will answer, an ape-like creature first recognized that it or he had offended against the good of some other creature and so became conscious of sin, or was created as a moral being. Thus much Mr. Darwin has affirmed, but (speaking from memory) I do not think he has called very special attention to that still greater epoch (or was it the same?) in man's history, when this ape-like creature, seeing one of its own species lying dead, recognized as a fact "I shall die." This is what we may term the creation of man as an immortal being, for in the very conflict of the two facts—one, the reflecting being, the self-conscious I; the other, death, the seeming destroyer—lie embedded all man's future spiritual cravings for eternity. And the idea of God would come in the order of Nature, before either of these, to the creature which first reflected upon the source of its own existence, and recognized a "tendency in things which it could not understand." This is, in brief, the scientific account of man's creation, and of the growth of the ideas of natural religion within his mind; and we may remark in passing that it must be a singularly uncandid

and prejudiced mind which does not recognize that the book of Genesis, which, upon any theory, contains man's earliest thoughts about himself, expresses in allegorical fashion exactly the same views.

The same views are also apparently expressed by Prof. Max Müller, in a very beautiful passage in the article on Semitic Monotheism, in the same volume:

"The primitive intuition of God and the ineradicable feeling of dependence upon God could only have been the result of a primitive revelation in the truest sense of that word. Man, who owed his existence to God, and whose being centred and rested in God, saw and felt God as the only source of his own and all other existence. By the very act of the creation God had revealed Himself. Here He was, manifested in His works in all His majesty and power before the face of those to whom He had given eyes to see and ears to hear, and into whose nostrils He had breathed the breath of life, even the Spirit of God."

The first impression made by this passage may be, that, in speaking of a "revelation in the truest sense," it affords an instance of that hateful habit of using religious words in a non-natural sense. But a little deeper consideration will show that no possible definition of a revelation, accompanied and attested by miracles, can exclude the revelation made by Nature to the first man who thought. In fact, we have here a description of creation, which science, with possibly a little suspiciousness at some of the phrases, may accept, while, at the same time, natural religion is carried to its utmost and highest limits, and along with this a foundation is laid for a truer theory of the miraculous. But, while gladly admitting all this, the fact remains that these intuitions, following upon a revelation in which Nature herself was the miracle, are still plainly only the expressions of man's inward experiences, and that, however old, and venerable, and exalted, they are still only hopes, wishes, and aspirations, which may or may not be true, but which are incapable of proving the actual facts toward which they soar. It is open, therefore, to any man, accustomed to look for positive demonstration, to dismiss them as dreams of the infancy of man, or to relegate them into the prison-house of the incomprehensibilities, or to content himself with a purely natural theory of human life which rejects and dislikes the theological.

2. But when we come to inquire how far these primary intuitions have been universal, and whether they can be fairly called ineradicable, we are met by some very startling facts. The dictum *ὃ πᾶσι δόκει τοῦτό εἶναι φαμεν* is so reasonable in itself that no serious attempt would be made to question a belief that even approached to being universal, even if it could not be shown to be part of the original furniture of the mind. But the real difficulty lies in finding (apart from morals) any beliefs of which this universality can be predicated, and assuredly the immortality of the soul is not one of them. The mind of man at its lowest seems incapable of grasping the idea, and the

mind of man at its highest has striven to emancipate itself from it altogether. The evidence for this statement lies within the reach of all, but I will just adduce three names whose very juxtaposition, by the sense of incongruous oddity stirred up, may make their joint testimony the more important. I mean Moses, Buddha, and Julius Cæsar, all of whom, though widely separated in time, race, and character, representing absolutely different types of human nature, approaching the subject from widely different points of view, do, nevertheless, agree in this, that the consciousness of immortality formed no part of the furniture of their minds.

Moses lived one of the most exalted lives, whether regarded from the religious or political side, that has ever been lived on earth, and yet, as is well known, there is not a shadow of a trace to prove that he was moved by the hope of a reward after death, or that the idea of existence after death was ever consciously presented to his mind. He may be, on the whole, claimed by modern science (the miraculous element being by it excluded) as an example of those who perform the greatest practical duties, and are content to stand before the mystery of the Unknowable without inquiry and without alarm, so far as the doctrine of man's immortality is concerned. Here is another of those strange links that unite the earliest thinker and legislator with so much of the spirit of modern thought and law. Buddha, on the contrary (or his disciples, if it be true that his original teaching is lost to us), cannot be quoted as one who did not realize the possibility of life after death, nor is any scheme of philosophy that is practically Pantheistic inconsistent with immortality, if we limit the word to the bare idea of existing somehow after death. But I rather quote him as one of those who show that the very consciousness of undying personal life, the existenee of a self-reflecting ego, which gives all its shape and force to the desire for life after death, may come to be regarded as a positive evil, and painless extinction be maintained as the ultimate hope and destiny of man. And the case of Julius Cæsar is, in some respects, stronger still. He is one of the world's crowning intellects, and he lived at a time when men such as he were the heirs of all the ages, the possessors of the treasures of thought in which, for generations past, the greatest men had elaborated doctrines concerning religion, duty, and life. And he represents the views of those whom the truest voice of science now repudiates as running into unscientific extremes. With him non-existence after death was a matter of practical belief. It colored his opinions upon politics, as really as Cromwell's religion affected his. He spoke against the infliction of the penalty of death upon the conspirators in Catiline's case, because death was a refuge from sorrows, because it solved all mortal miseries and left place for neither care nor joy. And Cato expressly applauded his sentiments, though with a touch of reaction from popular theology, which sounds strangely modern. To this, then, all the original

intuitions of the human mind, all the glowing aspirations enshrined in Greek poetry, legend, and art, all the natural theology contained in the works of Socrates and Plato, had come at last. Will any reasonable man affirm that an age, which breathes the very air of materialism, and whose children suck in the notions of changeless law with their mother's milk, will arrive at any thing better if it has no facts upon which to rely as proofs that its hopes are not unfounded? And how can that be called a truth of human nature, or be allowed to exercise a real influence upon men's minds, which is capable of being either entirely suppressed, or earnestly striven against, or contemptuously rejected?

3. The remaining two arguments need not detain us long; indeed, I should not have mentioned them, were it not that very eminent divines have based the belief in immortality upon the existence of God or the necessities of man. Let it once be granted that we are the creatures of a personal, loving, and sustaining God, concerning whom it is possible to form adequate conceptions, and then doubts as to our immortality would be vain indeed. But the rejoinder from the scientific view is plain enough. This, it would be said, is a mere *obscurum per obscurius.* The belief in God is simply the working of the human mind striving to account for the beginning of its own existence, exactly as the belief in immortality is the result of the attempt to think about the end thereof. If the definition of God be a stream or tendency of things that we cannot otherwise account for, then it will not help us to a belief in immortality. It is surprising indeed to see how the plain conditions of the case are evaded by enthusiastic controversialists; and I am almost ashamed of being obliged to make statements that have an inevitable air of being the baldest truisms.

4. The idea that immortality is essential to the moral development of man, and that therefore it is demonstrably true, seems to receive some little countenance from Prof. Max Müller in the close of his article on Buddhism, in which he thinks it improbable that—

> "The reformer of India, the teacher of so perfect a code of morality, ... should have thrown away one of the most powerful weapons in the hands of every religious teacher, the belief in a future life, and should not have seen that, if the life was sooner or later to end in nothing, it was hardly worth the trouble which he took himself, or the sacrifices which he imposed upon his disciples."

The true bearing, in all its immense importance, of man's morality upon his belief in immortality will have to be considered hereafter; but, when used as a demonstration, it is at once seen to belong to the class of arguments from final causes which science resolutely rejects. A much more fatal answer, however, is found in a simple appeal to history, from which it will be found that, in Mr. Froude's words, no doctrine whatever, even of immortality, has a mere "mechanical

effect" upon men's hearts and consciences, and that noble lives may be lived and exalted characters formed by those who are brave enough to disregard it. Nay, what is worse, immortality may be a powerful weapon for evil as for good, if it chime in with a perverted nature. The Pharaoh before whom Moses stood believed it, and we know with what results. Only that, once more will science retort, which can be proved to be true upon sufficient evidence, can be positively known to be useful.

To sum up, then, what has been said, we have seen that, however strong may be the wishes of man for immortality, however ennobling to his nature and true to his instincts the belief in it may be, there is nothing in natural religion to answer the demands of modern thought for actual proof, and nothing therefore to impugn the wisdom or refute the morality of that class of persons, representing, as they do, a growing tendency in the human mind, who take refuge in a suspense of thought and judgment upon matters which they declare are too high for them. Occasionally we may suspect that the garb of human weakness does but conceal the workings of human pride, never perhaps so subtle and so sweet as when human nature meekly resolves to be contented with its own imperfections, and to bow down before its own frailty; but denunciations of moral turpitude only harden the hearts of men who ask for the bread of evidence and receive stones in the shape of insults.

We turn next to consider the effects of modern thought upon the evidence for immortality derived from Revelation. And here the difficulty of obtaining assent to what seem to me obvious truths will be transferred from the advocates of religion to those of science. Nevertheless, I maintain an invincible conviction that it is possible to state the terms of debate in propositions which commend themselves to candid minds, and which do not, as I have said, pretend to solve the controversy, but merely to define its conditions.

Now, the first proposition is: That the Resurrection of Jesus Christ, if assumed to be true, does present actual scientific evidence for immortality. An illustration will make my meaning clear. Whether or not life can be evolved from non-living matter is a subject of debate; but it is admitted on all hands that, if a single living creature can be produced under conditions that exclude the presence of living germs, then the controversy is settled, and therefore Dr. Bastian sets himself to work with the necessary apparatus to prove his case. So, in the same way, if any man known to be dead and buried did rise again (as for the moment is assumed to be the case), and did think and act and speak in His own proper personality, then immortality (in the scientific sense of the word) is thereby proved. Accordingly, those who wish to prove their case, betake themselves to history for the required evidence, which they may or may not find, but which, such as it is, must be allowed to go to the jury. Science may refuse to listen

to arguments for facts derived from men's hopes and beliefs; it ceases to be science if it refuses to listen to arguments which profess to rely upon facts also. Were there to happen now an event purporting to resemble the Resurrection, it would be necessary to examine the evidence exactly as men are commissioned to investigate any unusual occurrence, say, for instance, the supposed discovery of fertile land at the North Pole. All this is plain enough, and leads to no very important conclusions, but it is, nevertheless, necessary that it should be stated clearly, and distinctly apprehended.

Two other propositions may also be laid down as to the nature of the evidence for the Resurrection, both of them once more sufficiently obvious, but still not without their value in leading to a fair and reasonable estimation of the exact state of the case, and tending also, as we shall see presently, in one direction. It may be taken for granted, in the first place, that nothing can be alleged against the moral character of the witnesses, or against the morality which accompanied and was founded upon the preaching of the Resurrection. Mistaken they may have been, but not dishonest; enthusiasts, but not impostors. Furthermore, the deeper insight into character, which is one of the results of the modern critical spirit, enables us to see that they numbered among their ranks men of singular gifts, both moral and intellectual, who combined in a wonderful degree the faculty of receiving what was, or what they thought to be, a miraculous revelation, and the power of setting it forth in a sober and measured manner. All this is candidly admitted by the best representatives of modern thought.

Again, it may safely be asserted that, judged by the critical standards of historical science, the evidence is abundantly sufficient to prove any event not claiming to be miraculous. Let us suppose such an event as an extraordinary escape from prison related in the same way, though I admit that it requires a considerable intellectual *tour de force* to eliminate, even in imagination, the supernatural from the narrative. It is not going too far to say that no real question as to its truth would in that case ever be raised at the bar of history, even though a powerful party were interested in maintaining the contrary. A strictly scientific investigation, for instance, has brought out in our own days the absolute accuracy and consequent evidential value of the account of St. Paul's voyage to Malta. On the whole, then, we may conclude that the testimony is really evidence in the case, that it proceeds from honest and capable men, and that no one, *apart from the existence of the supernatural element*, would care to deny its truthfulness, except upon grounds that would turn all history into a mass of fables and confusion.

There remains, then, the old argument, that it is more easy to believe the witnesses to be mistaken than the fact itself to be true, and that we cannot believe a miracle unless it be more miraculous to

disbelieve it. To this argument I avow my deliberate conviction, after the best thought I can give the subject, that no answer can be given regarded from a merely intellectual point of view, and subject to the conditions which modern thought not only prescribes, but is strong enough to enforce. It goes by the name of Hume, because he was the first to formulate it, but it is not so much an argument as a simple statement of common experience. All men who, from the days of St. Thomas, have disbelieved in miracles, have done so practically upon this ground. And to the "doubting" Apostle may be safely attributed the first use of the now famous formula, "It is much more likely that you, my friends, should be mistaken than that He should have risen." Now, to such a state of mind, what answer short of another miracle could be given then, or can be given now? True, you may point out the moral defects in the mind of Thomas which led him to disbelieve, but these are immediately counterbalanced by a reference to the intellectual defects of Mary Magdalene, which prompted her to accept the miracle. There is no real room for weighing the evidence on both sides, and pronouncing for that which has the greatest probability, when your opponent, by a simple assertion, reduces all the evidence on one side to zero. Once more let me ask Christian apologists to realize this, and having realized it, no matter at what cost to the fears and prejudices of theology, let us then proceed the more calmly to examine what it precisely means and to what conclusions it leads us.

We observe, first, that this argument is derived not from the first of the two ways in which, as we saw, science influences belief, namely, by altering the nature of the evidence required, but from the second, namely, by predisposing the minds of men against belief upon any attainable evidence whatever. We have seen that the evidence is that of honest men, that it is scientifically to the point, and sufficient to prove ordinary historical events. More than this cannot be demanded in the case of events which do not come under law or personal observation. But the minds of men are so predisposed by their experience of unchanging order to reject the miraculous, that, first, they demand more and more clear evidence than in other cases; and, secondly, they have recourse at once to the many considerations which weaken the force of evidence for things supernatural, and account for men's mistakes without impugning their veracity. Any one who reads Hume's essay will be struck at once with the, so to speak, subjectivity of the argument. Upon this very point he says, "When any one tells me he saw a dead man restored to life, I immediately *consider within myself*," etc., etc.. We ask then, at once, "To whom is it more likely that evidence of a miracle should be false than that the miracle should be true?" and the answer must of course be, "Those who, rightly or wrongly, are predisposed in that direction, by their experience of a changeless law, growing ever wider and more

comprehensive." Nor is Paley's answer, which assumes the existence of God, at all available as against Hume, who, in his next section, puts into the mouth of an imaginary Epicurus all the arguments against such a belief. But it is a most just and reasonable remark that this predisposition does not exist in the case of those who—again rightly or wrongly—are wishing to know God and hoping to live after death. It is at this point that natural and revealed religion, weak when divided, becomes strong by combination. The Resurrection would certainly never be believed if it did not fall like a spark upon a mass of wishes and aspirations which are immediately kindled into life. Granted a man (and this is no supposition, but a fact), whose whole nature craves not to die, and whose mind is occupied by the standing miracle of its own immortality, and then the Resurrection, so far from being improbable, will be the very thing which gives life to his hopes. The more he sees that natural religion cannot give him facts as proofs, the more he will welcome Revelation which does, just because it will satisfy the rational desire which science is creating in the human mind. And just as there is no answer to Hume's argument for one predisposed as Hume was, so is there none to one predisposed as this supposed (but very actual) man is. The one is as incapable of disbelief as the other of assent. Hume and Paley do not really grapple with each other, but move in parallel lines that never meet. As Hume himself said of Berkeley, "His arguments admit of no answer and produce no conviction," so might each of the two say of the other. On the one hand, we have all the results of human experience, a severe standard of intellectual virtue, a morality which confines itself to its duties toward humanity, and the power of being able not to think about ultimate incomprehensibilities. On the other hand, we have intense longings after the infinite, which science, admitting, as it does, the existence of the Unknowable, cannot possibly deny to be legitimate in those who feel them sincerely; also a body of evidence, sufficient to prove ordinary events, for a fact that gives certainty and power to all these longings; a morality, which has reference to a Supreme Judge, and an absolute incapacity for life and duty until some sort of conclusion has been arrived at concerning the mysteries of our being and destiny. Both of these represent tendencies of human nature with which the world could at this stage very badly dispense; both may have their use and their justification; either may be true, but *both* cannot, for the Resurrection either did or did not happen.

From this account of things some very important considerations follow, a few of which I will endeavor to sum up in three heads. The scientific value of Revelation as a necessity, if there is to be any vital and practical religion at all, will, I hope, have been sufficiently indicated already:

1. The lines of a long and, perhaps, never-ending conflict between

the spirit of Religion and what, for want of a better word, I will call the spirit of Rationalism, are here defined. Neither of the two being able by mere argument to convince the other, they must rely upon gradually leavening the minds of men with prepossessions in the direction which each respectively favors. The time may come when Rationalism will have so far prevailed that a belief in the miraculous will have disappeared; the time may also come when the Christian Revelation, historically accepted, will everywhere be adopted as God's account to man of ultimate incomprehensibilities. Surely, no man who has ever fairly examined his own consciousness can deny that elements leading to either of these two conclusions exist within his own mind. He must be a very hardened believer to whom the doubt, "Is the miraculous really possible?" never suggested itself. And he must in turn be a very unscientific Rationalist who has never caught himself wondering whether, after all, the Resurrection did not take place. Nor, so far as we may at this epoch discern the probable direction of the contest, is it possible to estimate very accurately the influence which science will exercise upon it. On the one hand, it will certainly bring within the mental grasp of common men that view of law and causation which, in Hume's time, was confined to philosophers and their followers, and was attained rather by intellectual conceptions than by such common experiences of every-day life and thought as we have at present. On the other hand, it will purge religion of its more monstrous dogmas, and further, by calling attention to the necessity of proving fact by fact, and again, by clearing up the laws of evidence, will tend to deepen in the minds of religious people the value and meaning of Revelation; while, at the same time, by its frank admission of hopeless ignorance, it will concede to faith a place in the realm of fact. Every man will have his own views as to the issue of the conflict: for the present it is sufficient for him, if he can be fully satisfied in his own mind.

2. The predisposition in men's minds in favor, whether of Religion or Rationalism, will be created and sustained solely by moral means. This is the conclusion toward which I have been steadily working from the beginning of this paper to the end of it. The intellect of both Christian and Rationalist will have its part to play; but that part will consist in presenting, teaching, and enforcing each its own morality upon the minds of men. I need not say that I use the word morality as expressing in the widest sense all that is proper for and worthy of humanity, and not merely in the narrower sense of individual goodness. Rationalism will approach mankind rather upon the side of the virtues of the intellect. It will uphold the need of caution in our assent, the duty of absolute conviction, the self-sufficiency of men, the beauty of law, the glory of working for posterity, and the true humility of being content to be ignorant where knowledge is impossible. Religion will appeal to man's hopes and wishes recorded

in Nature and in history, to his yearnings for affection, to his sense of sin, to his passion for life and duty, which death cuts short. And that one of the two which is truest to humanity, which lays down the best code of duty, and creates the strongest capacity for accomplishing it, will, in the long-run, prevail; a conclusion which science, so far as it believes in man, and religion, so far as it believes in God, must adopt. Here, once more, it is well nigh impossible to discern the immediate direction of the conflict, whatever may be our views as to its ultimate decision. Science is almost creating a new class of virtues; it is laying its finger with unerring accuracy upon the faults of the old morality; it is calling into existence a passion for intellectual truth. But then Religion has always given the strongest proofs of her vitality by her power of assimilating (however slowly) new truths, and of rejecting (alas! how tardily) old falsehoods, at the demands of reason and discovery. A religious man can always say that Christians, and not Christianity, are responsible for what goes amiss. It is because religious practice never has been, and is at this moment almost less than ever, up to the standard of what religious theory exacts, that we may have confidence in gradual improvement and advance, until that standard, toward the formation of which science will have largely contributed, be attained.

3. Closely connected with the above, follows the proposition that all attempts on the part of religion to confute the "skeptic" by purely intellectual methods are worse than useless. There is no intellectual short cut to the Christian faith; it must be built up in the minds of men by setting forth a morality that satisfies their nature, consecrates humanity, and establishes society. It is not because men love the truth, but because they hate their enemies, that in things religious they desire to have what they can call an overwhelming preponderance of argument on their side of the question, the possession of which enables them to treat their opponents as knaves or fools or both. Religion may have been the first to set this pernicious example, but, judging from the tone of much modern writing, Rationalism has somewhat bettered her instructions. No doubt it is a tempting thing to mount a big pulpit, and then and there, with much intellectual pomp, to slay the absent infidel—absent no less from the preacher's argument than from his audience. Delightful it may be, but all the more dangerous, because it plunges men at once into that error, so hateful to modern thought, of affirming that intellectual mistakes are moral delinquencies. No one, least of all science, denies that men are responsible for the consequences of their belief, provided these consequences are limited to such as are capable of being recognized and foreseen, and are not extended to comprehend endless perdition in a future state—an idea which is supposed, rightly or wrongly, to lurk beneath the preacher's logical utterances, and which religion has done next to nothing to disavow. And so we come to this conclusion: to build up by precept

and example a sound and sufficient morality; to share in all the hopes and aspirations of humanity; to be foremost in practical reforms; to find what the instincts of mankind blindly search for by reference to the character of God finally revealed in Christ, and to the hope of immortality which His Resurrection brought to light; to endeavor to clear religion from the reproach of credulity, narrowness, timidity, and bitter sectarian zeal; these are, as our Master Himself assured us, the only means of engendering in the hearts of men that moral quality which we call Faith: for "HE THAT IS OF THE TRUTH HEARETH MY VOICE."

In a future paper I hope to show, by reference to the facts of man's nature, how this faith in immortality is being, and is to be, so far wrought into his mind as to form a predisposition toward a belief in the Christian doctrine of the Resurrection of Christ as a proof of that which he cannot help but desire to believe.—*Contemporary Review.*

THE SOURCE OF LABOR.

SCIENCE has taught us that the processes going on around us are but changes, not annihilations and creations. With the eye of knowledge, we see the candle slowly turning into invisible gases, nor doubt for an instant that the matter of which the candle was composed is still existing, ready to reappear in other forms. But this fact is true not only of matter itself, but also of all the influences that work on matter. We wind up the spring of a clock, and, for a whole week, the labor thus stored up is slowly expended in keeping the clock going. Or, again, we spend five minutes of hard labor in raising the hammer of a pile-driver, which, in its fall, exerts all that accumulated labor in a single instant. In these instances, we easily see that we store up labor. Now, if we put a dozen sovereigns in a purse, and none of them be lost, we can take a dozen sovereigns out again. So in labor, if no labor be lost, as science asserts—for the inertia of matter, its very deadness, so to speak, which renders it incapable of spontaneously producing work, also prevents its destroying work when involved in it—we should be able to obtain back without deduction all our invested labor when we please.

Imagine a mountain-stream turning an overshot wheel. It thus falls from a higher to a lower level. A certain amount of labor would be required to raise the water from the lower level to the higher; just this amount of labor the water gives out in its fall, and invests, as it were, in the wheel. If, however, when arrived at the lower level, the water were to demand of the wheel to be pumped up again, the slighest trial would show that it would ask more than it could obtain,

though not more than it had given. The wheel, if questioned as to the cause of its inability, must reply as others have done, that it has shut up part of the labor in investments which it cannot realize. The reason, as commonly stated, is, that friction has destroyed part of the labor. The labor is not, however, destroyed. Science has shown that heat and labor are connected; labor may be turned into heat, and heat into labor. The labor absorbed by friction, is but turned into heat. If, however, we try to extract labor from the heat thus diffused through the different parts of the water-wheel, and make it available, we find ourselves quite at a loss. The heat gradually diffuses itself through surrounding bodies, and, so far as we are concerned, the labor is wasted, though it still exist, like Cleopatra's pearl dissolved in the cup of vinegar.

If no labor is lost, so neither is any created. The labor we exert is but the expenditure of labor stored up in our frames, just as the labor invested in the wound-up spring keeps the clock going. Whence, then, does all this labor originally come? We see the waste—how is compensation made? The answer is simple and easy to give. All the labor done under the sun is really done by it. The light and heat which the sun supplies are turned into labor by the organizations which exist upon the earth. These organizations may be roughly divided into two classes—the collectors and the expenders of the sun's labor. The first merely collect the sun's labor, so as to make it available for the other class; while, just as the steam-engine is the medium by which the steam gives motion, so this second class is the medium by which the sun's heat is turned into actual labor.

Still, the sun does not work only through organized labor: his mere mechanical influence is very great. With the moon—the only second post he deigns to fill—he produces the tides by his attraction on the sea. But for the friction of the earth and sea, the tides, once set in motion, would rise and fall without any further effort; but the work done in overcoming the friction is, though due to the sun and moon, not extracted from them, but by them from the earth. For it would take a vast effort to cause the earth to cease rotating. All this effort is, as it were, stored up in the revolving earth. As the tidal waters, then, rub along the bed of the sea, or the waters on which they rest and the adjacent coasts, this friction tends to make the earth move faster or slower, according to the direction in which the tidal flow is. The general effect is, however, that the friction of the tides makes the earth revolve more slowly; in other words, that part of the energy of rotation of the earth, so to speak, is consumed in rubbing against the tidal waters. All the work, therefore, that the tides do in undermining our cliffs, and washing away our beaches, is extracted by the sun and moon from the work stored up in the rotation of the earth. The diminution of rotation, indeed, is so small as scarcely to be perceived by the most refined observation, but the reality of it is now gener-

ally recognized; and this process, too, will apparently go on till the earth ceases to rotate on its axis, and presents one face constantly to the sun.

Thus we see that the destruction of the land by the sea, so interesting in a geological point of view, is partly due to the sun's action. Not only is he the source of the light and heat we enjoy, but he aids in forming the vast sedimentary beds that form so large a part of the crust of the earth, mixing the ingredients of our fields, and moulding our globe.

By heating the air, the sun produces winds, and some of the labor thus expended is made use of by man in turning his windmills, and carrying his wares across the sea. But there is another expenditure of the sun's heat more immediately useful to man. By evaporating the sea and other bodies of water, he loads the air with moisture, which, when in contact with cold mountain-peaks or cold masses of air, loses its heat, and, being condensed, falls as rain or snow. Thus the rivers are replenished, which for a long time supplied the greater part of the labor employed in manufactures, though the invention of the steam-engine is fast reducing relatively the value of this supply of labor.

But vast as the sun's power thus exerted is, and useful as it is to man, it is surpassed in importance by his labor exerted through organized beings. The above-named agents have one defect: on the whole, they are incapable of being stored up to any great degree; we must employ them as Nature gives them to us. Organized existence, however, possesses the power of storing up labor to a very high degree. The means it adopts are not mechanical, but chemical. The formation of chemical compounds is attended with the giving out of heat, which, as we have said before, is equivalent to labor, and, if of sufficient intensity, can by us be made available as labor, as in the steam-engine. Now, we take iron-ore, consisting of iron in combination with other substances. By means of great heat, the iron is set free in the smelting-furnace. The iron, then, in its change of form has, as it were, taken in all this heat. If, now, we take this iron, and, keeping it from the influence of the air, reduce it to very fine powder, and then suddenly expose it to the air, by the force of natural affinity, it will absorb the oxygen of the air, and in so doing give out the heat before required to set it free from the oxygen; and if the iron be in small enough portions, so that the process is sufficiently rapid, we may see the iron grow red-hot with the heat thus disengaged.

Now, plants and trees, by the aid of the solar light and heat, remove various substances, carbon especially, from what seem to be their more natural combinations, and in other combinations store them up in their structures. Take a young oak-tree with its first tender leaves; if deprived of the sun's light and heat, its growth would be stayed, and its life die out. But, with the aid of the sun's rays, it absorbs

carbon from the gases in the air, each particle of carbon absorbed being absorbed by the power of the sun through the agency of the plant, and with each particle of carbon stored up is also, as it were, stored up the labor of the sun by which that particle was set free from its former fetters. The sap of the plant, thus enriched, returns in its course, and by some mysterious process is curdled into cells and hardened into wood. But the work by which all this was accomplished lies hid in the wood, and not only is it there, but it is there in a greatly-condensed state. To form a little ring of wood round the tree, not an eighth of an inch across it, took the sunshine of a long summer, falling on the myriad leaves of the oak.

Lemuel Gulliver, at Laputa, was astonished by seeing a philosopher aiming at extracting sunbeams from cucumbers. Had he but rightly considered the thing, he would have wondered at any one's troubling to make a science of it. The thing has always been done. From Adam and Eve in the garden of Eden eating sweet fruits, through the onion-eating builders of the pyramids, down to the flesh-eating myriads of our land, this process has always been going on. The active life of reasoning man, and his limitless powers of invention, need for their full development a vast supply of labor. By means of the vegetable kingdom, the sun's work is stored up in a number of organic substances. Man takes these into his system, and in the vessels and fibres of his body they resume their original combinations, and the labor of the sun is given out as muscular action and animal heat. To allow a larger supply of labor for man's intellect to work with, Providence created the herbivorous races. Some of these further condense the work of the sun involved in plants, by taking these plants into their systems, and storing up the work in them, in their flesh and fat, which, after some preparation, are fit to be received into the frame of man, there, as the simpler vegetable substances, to supply heat and labor. Others, extracting work from the vegetable kingdom, just as man does, and mostly from parts of the vegetable kingdom that are not suited to the organs of man, are valuable to man as sources of labor, since they have no power to invent modes of employing this labor to their own advantage. Man might have been gifted with a vaster frame, and so with greater power of labor in himself, but such a plan had been destitute of elasticity, and, while the savage would have basked in the sun in a more extended idleness, the civilized man had still lacked means to execute his plans. So that Good Providence which formed man devised a further means for supplying his wants. Instead of placing him at once on a new-formed planet, it first let the sun spend its labor for countless ages upon our world. Age by age, much of this labor was stored up in vast vegetable growths. Accumulated in the abysses of the sea, or sunk to a great depth by the collapse of supporting strata, the formation of a later age pressed and compacted this mass of organic matter. The beds thus formed were

purified by water, and even by heat, and at last raised to within the reach of man by subterranean movements. From this reservoir of labor, man now draws rapidly, driving away the frost of to-day with the sunshine of a million years ago, and thrashing this year's harvest with the power that came to our earth before corn grew upon it.

Such are the processes by which the sun's power is collected and stored up by the vegetable kingdom in a form sufficiently condensed to be available for working the machinery of the bodies of men and beasts, and also to assist man in vaster expenditures of labor. It is most interesting to trace such processes, and not only interesting, but also instructive, for it shows us in what direction we are to look for our sources of labor, and will at once expose many common delusions. One hears, perhaps, that something will be found to supplant steam. Galvanism may be named; yet galvanism is generated by certain decompositions—of metal, for instance—and this metal had first to be prepared by the agency of coal, and in its decomposition can give out no more labor than the coal before invested in it. It is as if one should buy a steam-engine to pump up water to keep his mill-wheel going. The source of all labor is the sun. We cannot immediately make much use of his rays for the purposes of work; they are not intense enough; they must be condensed. The vegetable world alone at present seems capable of doing this; and its past results of coal, peat, petroleum, etc., and present results of wood and food, are ultimately all we have to look to.

To say that man will ever be dependent upon the vegetable world for all his work, may be considered bold, but there is certainly great reason to believe it. The sun's labor being supplied in such a diluted form, each small quantity continually supplied must be packed in a very small space. Now, man can only subject matter to influences in the mass. The little particle of carbon that the plant frees each instant is beyond his ken. The machinery he could make would not be fine enough: it would be like trying to tie an artery with the biggest cable on board the *Great Eastern*. Organized existence possesses machinery fine enough to effect these small results, and to avail itself of these little instalments of labor. At present, this machinery is beyond our comprehension, and possibly will ever remain so. Nature prefers that her children should keep out of the kitchen, and not pry into her pots and pans, but eat in thankfulness the meal she provides.

Some interesting results follow from what has been stated above. One is, that we are consuming not only our present allowance of the sun's labor, but also a great deal more, unless the formation of coal in our age equals its consumption, which is not probable. Mother Earth will certainly, so far as we can see, some day be bankrupt. Such a consummation is pointed to, however, in other quarters. The sun's heat, unless miraculously replenished, must gradually be dissipated through space. There are reasons for thinking that the planets must

ultimately fall into the sun. These things, however, possess to us no practical physical interest. Such countless ages must elapse ere they affect man's material condition upon earth, that we hardly can gravely consider them as impending. The chief interest they excite is moral. Like the man's hand that appeared to the revelling king, they write "Mene, Mene, Tekel, Upharsin" (Weighed, measured, limited, doomed) on our material world, and dimly point to some power that stands, as it were, hidden from our view behind the screen of matter, "that shall make all things new."—*Chambers's Journal.*

QUETELET ON THE SCIENCE OF MAN.[1]

By E. B. TYLOR.

TWO lines of research into the Science of Man, of the highest moment as well in theoretical Anthropology as in practical Ethics and Politics, both to be always associated with the name of Quetelet, are now discussed at large in his Social Physics and Anthropometry. The two great generalizations which the veteran Belgian astronomer has brought to bear on physiological and mental science, and which it is proposed to describe popularly here, may be briefly defined: First, he has been for many years the prime mover in introducing the doctrine that human actions, even those usually considered most arbitrary, are in fact subordinate to general laws of human nature; this doctrine, maintained in previous publications, especially in the earlier edition of the first-named work some thirty-seven years ago, is now put forth in its completest form. Second, he has succeeded in bringing the idea of a biological type or specific form, whether in bodily structure or mental faculty, to a distinct calculable conception, which is likely to impress on future arguments a definiteness not previously approached.

The doctrine of the regularity and causality of human actions was powerfully stated some fifteen years ago by Mr. Buckle in the introduction to his "History of Civilization." Buckle is here essentially the exponent of Quetelet's evidence, from which, indeed, as a speculative philosopher, he draws inferences more extreme than those of his statistical teacher. To Quetelet is due the argument from the astonishing regularity from year to year in the recurrences of murders and suicides, a regularity extending even to the means or instruments by which these violent acts are committed; his inference being broadly that "it is society which prepares the crime, the criminal being only

[1] Physique Sociale, ou Essai sur le Développement des Facultés de l'Homme. Par Ad. Quetelet. (Brussels, 1869.)

Anthropométrie, ou Mesure des différentes Facultés de l'Homme. Par Ad. Quetelet. (Brussels, 1870.)

the instrument which executes it." From various other sources Buckle brought together other pieces of evidence, especially one which is now quoted by all who discuss the subject, the regularity from year to year of letters posted, whose writers forget to direct them. It may by this time be taken as proved by such facts that each particular class of human actions may be estimated, and, to a great extent, even predicted, as a regular product of a definite social body under definite conditions. To quote another luminous instance of this regularity of action, M. Quetelet gives a table of the ages of marriage in Belgium ("Phys. Soc.," i., p. 275). Here the numbers of what may be called normal marriages, those between men under 45 with women under 30, as well as of the less usual unions where the women are between 30 and 45, show the sort of general regularity which one would expect from mere consideration of the circumstances. The astonishing feature of the table is the regularity of the unusual marriages. Disregarding decimals, and calculating the approximate whole numbers in their proportion to 10,000 marriages, the table shows, in each of five five-year periods from 1841 to 1865, 6 men aged from 30 to 45 who married women aged 60 or more, and 1 to 2 men aged 30 or less who married women aged 60 or more. M. Quetelet may well speak of this as the most curious and suggestive statistical document he has met with. These young husbands had their liberty of choice, yet their sexagenarian brides brought them up one after the other in periodical succession, as sacrifices to the occult tendencies of the social system. The statistician's comment is: "It is curious to see man, proudly entitling himself King of Nature, and fancying himself controlling all things by his free-will, yet submitting, unknown to himself, more rigorously than any other being in creation, to the laws he is under subjection to. These laws are coördinated with such wisdom that they even escape his attention."

The admission of evidence like this, however, is not always followed by the same philosophical explanation of it. Buckle finds his solution by simply discarding the idea that human action "depends on some capricious and personal principle peculiar to each man, as free-will or the like;" on the contrary, he asserts "the great truth that the actions of men, being guided by their antecedents, are in reality never inconsistent, but, however capricious they may appear, only form part of one vast scheme of universal order, of which we, in the present state of knowledge, can barely see the outline." M. Quetelet's argument from the same evidence differs remarkably from this. His expedient for accounting for the regularity of social events, without throwing over the notion of arbitrary action, is to admit the existence of free-will, but to confine its effects within very narrow bounds. He holds that arbitrary will does not act beyond the limits at which science begins, and that its effects, though apparently so great, may, if taken collectively, be reckoned as null, experience proving that indi-

vidual wills are neutralized in the midst of general wills (p. 100). Free-will, though of sufficient power to prevent our predicting the actions of the individual, disappears in the collective action of large bodies of men, which results from general social laws, which can accordingly be predicted like other results regulated by natural laws. We may perhaps apprehend the meaning of Quetelet's views more clearly from another passage, where, to show how apparently isolated events may be really connected under some wide law, he compares single facts to a number of scattered points, which seem not related to one another till the observer, commanding a view of a series of them from a distance, loses sight of their little accidents of arrangement, and at the same time perceives that they are really arranged along a connecting curve. Then the writer goes on to imagine, still more suggestively, that these points might actually be tiny animated creatures, capable of free action within a very narrow range, while nevertheless their spontaneous movements would not be discernible from a distance (p. 94), where only their laws of mutual relation would appear. M. Quetelet can thus conciliate received opinions by recognizing the doctrine of arbitrary volition, while depriving it of its injurious power.[1] His defence of the existence of free-will is perhaps too much like the famous excuse of the personage who was blamed for going out shooting on the day he had received the news of his father's death, and who defended himself on the ground that he only shot very small birds. But it is evident that the statistics of social regularity have driven the popular notion of free-will into the narrow space included between Quetelet's restriction and Buckle's abolition of it. In fact, no one who studies the temper of our time will deny the increasing prevalence of the tendency of the scientific world to reject the use of the term free-will in its vulgar sense—that of unmotived spontaneous election—and even to discourage its use in any other sense as apt to mislead, while its defenders draw their weapons not so much from observation of facts as from speculative and dogmatic philosophy.

To those who accept the extreme principle that similar men under similar circumstances must necessarily do similar acts; and to those, also, who adopt the notion of free-will as a small disturbing cause which disappears in the large result of social law, the regularity of civilized life carries its own explanation. Society is roughly homogeneous from year to year. Individuals are born, pass on through stage after stage of life, and die; but at each move one drops into another's place, and the shifting of individuals only brings change into the social system, so far as those great general causes have been at work which difference one age from another—the introduction of different knowledge, different principles, different arts, different industrial materials and outlets. The modern sociologist, whatever his

[1] In regard to the relation of statistics to the doctrine of fatalism, see Dr. Farre's "Report on the Programme of the Fourth Session of the Statistical Congress."

metaphysical prepossessions, looks at society as a system amenable to direct cause and effect. To a great extent his accurate reckonings serve to give more force and point to the conclusions of rough experience; to a great extent, also, they correct old ideas and introduce new aspects of social law. What gives to the statistical method its greatest scope and power is, that its evidence and proof of law applies indiscriminately to what we call physical, biological, and ethical products of society, these various effects acting and reacting on one another. A few instances may be given to show the existence of the relations in question, without attempting to show their precise nature, or to trace the operation of other determining causes.

Thus, for instance, the mode of life affects its length. Statistics show that the mortality of the very poor is about half as much again as the mortality of the very rich; while, as to the influence of professions, it appears that, in Germany, only 24 doctors reach the age of 70 as against 32 military men and 42 theologians. The propensity to theft bears a distinct relation to age; thus the French criminal statistics estimate the propensity to theft between the ages of 21 and 25 as being five-thirds as much as between the ages of 35 and 40. The amount of criminality in a country bears a relation, indirect and as yet obscure, but unmistakable, to its education, or rather to its want of education. In France, in 1828–'31, the constant percentage of accused persons was about as follows: could not read or write, 61; imperfectly, 27; well, 12. The comparison of this group of numbers with those taken lately in England shows a great change of proportion, evidently resulting from the wider diffusion of education; but the limitation of crime to the less-educated classes is even more striking: cannot read or write, 36; imperfectly, 61; well, 3. Again, for an example of connection of physical conditions with moral actions, we may notice a table showing how the hours of the day influence people who hang themselves ("Phys. Soc.," ii., 240). The maximum of such cases, 135, occurred between six and eight in the morning; the number decreased slightly till noon, and then suddenly dropped to the minimum; there being 123 cases between ten and twelve o'clock, against only 32 between twelve and two o'clock. The number rose in the afternoon to 104 cases between four and six, dropping to an average of about 70 through the night, the second minimum, 45, being between two and four o'clock in the morning. Here it is impossible to mistake the influences of the periods of the day. We can fancy we see the poor wretches rising in the morning to a life of which the misery is beyond bearing, or can only be borne till evening closes in; while the temporary relief of the midnight sleep and the mid-day meal are marked in holding back the longing to self-destruction. Madness varies with the season of the year: the maximum being in summer, and the minimum in winter (p. 187); a state of things which seems intelligible enough. Again, it is well known in

current opinion that more children are born in the night than in the day; in fact, there are about five night-born against four day-born, the maximum being about midnight, the minimum a little before noon (i., p. 208). Why this is, no one yet knows; it is a case of unexplained law. But another not less curious law relating to births seems to have been at last successfully unravelled. In Europe about 106 boys are born to every 100 girls. The explanation appears to depend on the husband being older than the wife; which difference again is regulated by prudential considerations, a man not marrying till he can maintain a wife. In connection with this argument, it must be noticed that illegitimate births show a much less excess of male children (p. 168). Here, then (if this explanation may be accepted), it appears that a law, which has been supposed to be due to purely physiological causes, is traceable to an ultimate origin in political economy.

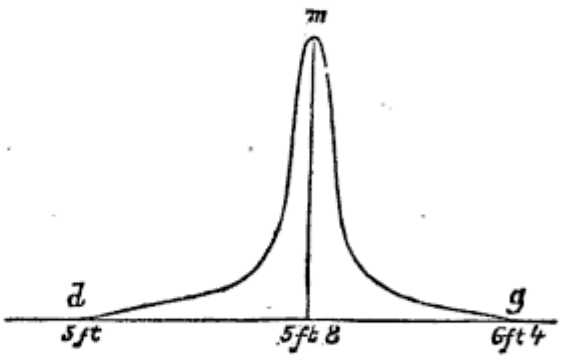
The examples brought forward by Quetelet, which thus show the intimate relation between biological and ethical phenomena, should be pondered by all who take an interest in that great movement of our time—the introduction of scientific evidence into problems over which theologians and moralists have long claimed exclusive jurisdiction. This scientific invasion consists mainly in application of exact evidence in place of inexact evidence, and of proof in place of sentiment and authority. Already the result of the introduction of statistics into inquiries of this kind appears in new adjustments of the frontier line between right and wrong, as measured under our modern social conditions. Take, for instance, the case of foundling hospitals, which provide a "tour," or other means, for the secret reception of infants abandoned by their parents. It has seemed, and still seems, to many estimable persons, an act of benevolence to found and maintain such institutions. But, when their operation comes to be studied by statisticians, they are found to produce an enormous increase in the number of exposed illegitimate children ("Phys. Soc.," i., p. 384). In fact, thus to facilitate the safe and secret abandonment of children is to set a powerful engine at work to demoralize society. Here, then, a particular class of charitable actions has been removed, by the statistical study of its effects, from the category of virtuous into that of vicious actions. An even more important transition of the same kind is taking place in the estimation of alms-giving from the ethical point of view. Until modern ages, through all the countries of higher civilization, men have been urged by their teachers of morality to give to the poor, worthy or unworthy; the state of public opinion being well exemplified by the narrowing of the word "charity" from its original sense to denote the distribution of doles. Yet, when the statistics of pauperism were collected and studied, it was shown that indiscriminate alms-giving is an action rather evil than good, its tendency being not only to maintain, but actually to produce, idle and miserable pau-

pers. In our time a large proportion of the public and private funds, distributed among the poor, is spent in actually diminishing their industry, frugality, and self-reliance. Yet the evil of indiscriminate alms-giving is diminishing under the influence of sounder knowledge of social laws, and genuine charity is more and more directed by careful study of the means by which wealth may be spent for the distinct benefit of society. Such examples as these show clearly the imperfection and untrustworthiness of traditional, or what is called intuitive morality, in deciding on questions of right and wrong, and the necessity of appealing in all cases to the best attainable information of social science to decide what actions are really for or against the general good, and are therefore to be classed as virtuous or vicious.

Moreover, it is not too much to say that the comparatively small advance which moral science has made, since barbaric ages, has been due to the repugnance of moralists to admit, in human action, the regular causality which is the admitted principle of other parts of the action of the universe. The idea of the influence of arbitrary will in the individual man has checked and opposed the calculations which now display the paramount action of society as an organized whole. One point in M. Quetelet's doctrine of society requires a mention for its practical bearing on morals. There has seemed to some to be an immoral tendency in his principle that virtuous and vicious acts are products, not merely of the individual who does them, but of the society in which they take place, as though the tendency of this view were to weaken individual responsibility, and to discourage individual effort. Yet, when properly understood, this principle offers a more strong and definite impulse to the effort of society for good and against evil, than the theory which refers the individual's action more exclusively to himself. M. Quetelet's inference from the regular production of a certain amount of crime year by year, from a society in a certain condition, is embodied in his maxim that society prepares the crime and the criminal executes it. This should be read with a comment of the author's. "If," he says, "I were to take up the pavement before my house, should I be astonished to hear in the morning that people had fallen and hurt themselves, and could I lay the blame on the sufferers, inasmuch as they were free to go there or elsewhere?" Thus every member of society who offers a facility to the commission of crime, or does not endeavor to hinder its commission, is, in a degree, responsible for it. It is absurd to suppose that the crimes in great cities are attributable altogether to the free agency of the poor wretches who are transported or hung for them. The nation which can and does not prevent the existence of a criminal class is responsible collectively for the evil done by this class. This we can see plainly enough, although the exact distribution of the responsibility among the different members of society may be impossible to determine. Such a theory, of course,

casts aside the revenge-theory of criminal law, assimilating the treatment of criminals to the operation of a surgeon healing a diseased part of the body, if possible, or, if not, rendering it harmless or removing it.

The wealthy and educated classes, whose lives seem to themselves as free from moral blame as they are from legal punishment, may at first hear with no pleasant surprise a theory which inculpates them as sharers in the crimes necessarily resulting from the state of society which they are influential in shaping. Yet this consideration is by no means one of mere hopeless regret, for coupled with it is the knowledge that it is in their power, by adopting certain educational and reformatory measures, so to alter the present moral status of society as to reduce the annual budget of crime to a fraction of its present amount. Thus the doctrine that the nation participates in and is responsible for the acts of its individual members is one which widens the range of duty to the utmost. The labors of M. Quetelet, in reducing to absolute calculation this doctrine of the solidarity of human society, entitle him to a place among those great thinkers whose efforts perceptibly raise that society to a higher intellectual and moral level. Here, as everywhere, the larger comprehension of the laws of Nature works for good and not for evil in the history of the world.



Some slight account has now to be given of M. Quetelet's doctrine of typical forms, as displayed in the "homme moyen," or "mean man," of a particular nation or race. This is no new theory; but, since the publication of the "Physique Sociale" in 1835, the author has been at work extending and systematizing it, his last results being shown in the present works. First, it must be pointed out that the term "homme moyen" is not intended to indicate what would be popularly meant by an "average man." An average or arithmetical mean of a number of objects may be a mere imaginary entity, having no real representative. Thus, an average chessman, computed as to height from the different pieces on the board, might not correspond to any one of the actual pieces. But the "homme moyen" or central type of a population really exists; more than this, the class he belongs to exceeds in number any other class, and the less nearly any other class approaches to his standard the less numerous that class is, the decrease in the number of individuals as they depart from the central type conforming to a calculable numerical law. The "mean man" (the term may probably be adopted in future researches, and when technically used its popular meaning will cease to inter-

fere with this special one)—the "mean man" thus stands as a representative of the whole population, individuals as they differ from him being considered as forms varying from his specific type.

To realize a conception which even among anthropologists has scarcely yet become familiar, it is desirable to show by what actual observations M. Quetelet was led to the discovery of his principle. When a large number of men of a practically homogeneous population are measured, and arranged in groups accordingly, it becomes evident that the individuals are related to one another by a law of distribution. A central type is represented by the most numerous group, the adjoining groups becoming less and less numerous in both directions. Thus, on classifying the measured heights of some 26,000 American soldiers of the Northern army during the late war, the proportionate number of men to each height was ascertained to be as follows ("Phys. Soc.," i., p. 131; "Anthropom.," p. 259):

Height, inches.....	60	61	62	63	64	65	66	67	68
No. of men in 1,000....	1	1	2	20	48	75	117	134	157
Height, inches.....	69	70	71	72	73	74	75	76	
No. of men in 1,000....	140	121	80	57	26	13	5	2	

Here it is seen that the mean man is a little under 5 ft. 8 in. in height, the numbers of men shorter and taller diminishing with evident regularity, down to the few representatives of the very short men of 5 ft. and under, and the very tall men of 6 ft. 4 in. and over. The law of relation of height to numerical strength is shown graphically by the binomial curve figured above, where the abscissæ (measured from an origin on the left) represent the heights of the men, and the ordinates the relative numbers of men corresponding to each height. The maximum ordinate, representing the number of mean men, is at m = about 5 ft. 8 in., the ordinates on both sides diminishing almost to nothing as they reach the dwarfish and gigantic limits d and g, and vanishing beyond.

Again, measurement around the chest, applied to the soldiers of the Potomac Army, shows a similar law of grouping ("Phys. Soc.," ii., 59; "Anthropom.," p. 289):

Round chest, inches.....	28	29	30	31	32	33	34	35
No. of men in 1,000.....	1	3	11	36	67	119	160	204
Round chest, inches.....	36	37	38	39	40	41	42	
No. of men in 1,000.....	166	119	68	28	13	4	1	

Here the mean man measures about 35 in. round the chest, the numbers diminishing both ways till we reach the few extremely narrow-chested men of 28 in., and the few extremely broad-chested men of 42 in. These two examples may represent the more symmetrical cases of distribution of individuals on both sides of a central type, as worked out by M. Quetelet from various physical measurements applied to large numbers of individuals. Here the tendency to vary is approximately

equal in both directions. Where the tendency to vary is perceptibly different in the two directions, the curve loses its symmetry, as in the figures representing the weights of women at different ages ("Anthropom.," p. 349), and the number of marriages of men and women at different ages ("Phys. Soc.," i., 272). The actual series of numbers given by observation are placed beside series computed according to the law of the expanded binomial, the same which is applied in the theory of probabilities to such calculations as that of the proportionate distribution of less probable events on each side of a most probable maximum term, the distribution of errors of observation of a single object, and of accidental variations in general. It is the closeness of approximation between the observed and calculated series of variations, computed not only as to the dimensions, but the actions of man, which gives to M. Quetelet's theory its remarkable definiteness and precision.

The diagram of statures here figured, which may be looked upon as representing a nation measured in one particular way, at once impresses on the mind a conception of a race-type materially differing from the vague notions hitherto current. It is seen that individual men of different statures are required to constitute a nation, but they are required in less and less proportion as they depart in excess or defect from the central type. The nation is not even complete without its dwarfs and giants. In fact, if all the monstrously short and tall men of a particular country were put out of sight, and the census of the population taken according to stature, the national formula thence deduced would enable a statistician to reckon with considerable accuracy how many dwarfs and giants of each size had been removed.

M. Quetelet's investigations further prove, or tend to prove, that similar laws of variation from the central type govern the distribution of individuals classed according to other bodily dimensions, and also according to physical qualities such as weight and strength, it being borne in mind that the particular expressions with their descriptive curves differ for the various qualities or faculties of man, being also in some cases much less symmetrical than in others. An absolute coincidence of the series of observed facts with the numerical law chosen to express them would be too much to expect; it is a great deal to obtain even a rough coincidence. For instance, when the strength of a number of men is estimated by a dynamometer, the maximum number showed 140 to 150 degrees on the scale, the number of weaker and stronger men being both fewer from this point, groups following approximately the proportions of the coefficients of a binomial of the sixth order; the numbers are reduced as follows from the table ("Anthropom.," p. 365):

Renal force, degrees.....	90	100–110	120–130	140–150	160–170
No. of men in 64.....	1	8	14	20	15
Binom. coeff.....	1	6	15	20	15

Renal force, degrees...	180–190	200
No. of men in 64.....	6	1
Binom. coeff.....	6	1

In the various numerical examples here given, the element of age is not introduced, the ages of the individuals being calculated or taken as uniform. The problem of variation of numerical distribution of a population at different ages is treated by M. Quetelet in a comparatively simple case, that of the stature-curve. Here a curve approximating to a parabola is laid down, the ages of man from birth onward being measured along its axis; each double ordinate of this curve forms the base on which a binomial curve is erected perpendicularly, the vertices of these curves forming a curve of mean stature, of the nature of a curve of mortality ("Anthropom.," p. 264). How far M. Quetelet may succeed in his contemplated purpose of carrying his method from the physical into the intellectual and moral nature of man, it is premature to judge.

Without entering into the more intricate and difficult problems opened by this theory of central types, it is evident that the bearing of its main conception on the problems of anthropology and biology in general is highly important. Some able anthropologists have accepted the theory of the mean, or central standard, as a basis for the comparison of races, but this line of research is still in its infancy. In M. Quetelet's last volume, a principle is worked out which serves as a bridge between the old and new methods. His experience is that, in a well-marked population, no extraordinary number of observations is required for the determination of the mean man. In former ages, one result of the national type being so preponderant in number and so easily recognizable was, that the bodily measurements of any man of ordinary stature and proportions could be trusted to give, with reasonable accuracy, the standard measures of the nation, such as the foot, cubit, fathom, etc. In the same manner M. Quetelet finds a small number of selected individuals sufficient for ascertaining the standard national proportions of the human body, male and female, from year to year of growth; his tables, founded for the most part on Belgian models, are given in an appendix. This method is applicable to the purposes of general anthropology. Thus a traveller, studying some African or American race, has to select by mere inspection a moderate number of typical men and women, by comparison of whose accurately admeasured proportions he may approximate very closely to a central race-type.[1] It is not necessary to dwell on the obvious difficulties

[1] Thus General Lefroy's measurements of thirty-three Chippewa Indians ("Journal of the Ethnological Society," vol. ii., p. 44, 1870) are sufficient to determine the stature of the mean man as about 5 ft. 7 in., the number of individuals in this maximum group being 8. It is even possible to guess from this small number of measurements the numerical law of variation in the tribe, the series of groups from five ft. 3 in. to 5 ft. 11 in. being as follows: 1, 1½, 2½, 6, 8, 4½, 4½, 3, 1.

of connecting the standard types of mixed nations with the races composing them. The stature-curve of England differs visibly in proportions from that of Italy, the measurements of Scotch and American soldiers show very different mean and extreme terms, and the problems of race underlying these differences are of a most complex character, the more so when the consideration is introduced of the race-type varying within itself from century to century. M. Quetelet is naturally apt, when expressing his views in an exordium or a peroration, to draw a good deal on the anticipated future results of his admirable method; but in judging of the value of his doctrine of central types, the best criterion is his actual success in reducing the observed facts of Nature to numerical calculation. The future must show how far it will be possible to apply to the theory of species the definition of central specific forms, from which varieties calculably diminish in numbers as they depart in type.—*Nature.*

DISINFECTION AND DISINFECTANTS.

By WILLIAM EASSIE, C. E.

THERE are certain rules to be promulgated respecting the protection of human life from contagion, or from the injurious effects of decomposing organic matters, which may be gleaned from the experience of ages, and which as yet have never been laid down with sufficient clearness.

A writer in a medical journal, the other day, pointed out, from the "Odyssey" of Homer, the great solicitude of Ulysses for the purification of his house with sulphur, and the history of purgation could go still farther back, and bring to light many other interesting *memorabilia.* This, however, hardly comes within the scope of these short papers; neither, as I said before, would any attempt to explain the cause of disease, for it would only be a repetition of wise things said before. Happily, too, the grim dwellers of the threshold are now watched with eye of lynx and nerve of steel, and their newer thrusts at poor mankind met or parried. Names like those of Drs. Parkes and Sanderson, in this respect, are fast becoming household words. For the purposes of this chapter, however, I cannot forbear from condensing the remarks of Dr. Angus Smith, with respect to disease generally. According to this authority, the classes of disease may be caused—firstly, by gases easily diffused in air, such as carbonic acid, nitrogen, marsh-gas, and others; secondly, by vapors falling in cold air and taken up in fogs, volatile bodies in fact, that concentrate in cool temperatures, and not to be classed with gases; thirdly, by putrid or decomposing substances,

that include, with the hurtful gases named under the first head, many organic forms which, transferred to a suitable soil, are capable of working havoc with life and health; and, fourthly, by those more organized bodies in various stages and ferments that have a definite existence, and that multiply the diseases to which they are most allied, whenever they meet with suitable fields for propagation.

Disinfection is practised by fits and starts. With us it has been mainly a summer practice, when our nostrils encounter the smell off offensive matters. Contagion seizes a house, or a town, and for a time the sanitary inspectors, and the awakened people themselves, distribute even the most noxious disinfectants without system, and with the inevitable result of expending the most money with the least possible good result. The destruction of valuable property, a senseless panic, and a relapse into the indulgence of time-honored abuses, are the common results of outbreaks of typhus or typhoid fevers, of small-pox, cholera, or any other of the many diseases by which we are punished for grave derelictions of duty. We cannot neglect with impunity the maintenance of personal and household cleanliness—ventilation, and an abundant supply of pure water. Soap and soda are the simplest expedients at our disposal for cleansing purposes. Experience teaches us that ancient cities, and even modern human dwellings, are admirably suited to act as reservoirs of contagion, and are constantly polluted by the excreta of the healthy as well as of the sick. We have, therefore, been compelled to resort to disinfection. But such has been our shortsightedness in the matter, that the employment of any agent to destroy infection is too often evaded, and has usually been rendered most distasteful and even painful. A nauseous coating has been put upon this very simple pill. A poor woman is sent to the oil-shop for a little chloride of lime; a foul room is thereby rendered unbearable, the place has to be thrown open, disinfection is not attained, and the *maximum* of discomfort is attended with a *minimum* of benefit.

Some medical men are, I fear, blamable for not estimating with greater precision the real benefits derived from the use of volatile disinfectants. They are all irritating and of bad odor, and a popular belief has arisen that, unless they are foul and caustic, they can do no good service. A distinguished chemist, Mr. J. A. Wanklyn, has very recently shown that the constitution of a poisoned atmosphere cannot be modified even in a small dwelling by an expenditure of material that would be certainly beyond the means of a wealthy person. To diminish the evils of a malign atmosphere, he says, "ventilate," and, while admitting the correctness of this, I shall humbly attempt to show that means may be employed for fixing the poisonous particles floating in a fever-chamber without rendering the air of that chamber irrespirable, or without killing a patient by draughts of cold air.

Disinfectants are employed as deodorizers and as contagion-destroyers. Such agents as carbolic acid prevent the decomposition of

organic matter, and therefore favor a state of atmospheric purity; but carbolic acid is not a deodorizer. It makes, but it does not absorb or destroy, fetid vapors: and it is for this reason that M. Lemaire and others have recommended the use of carbolic acid in conjunction with sulphate of zinc, salts of iron, chloride of lime, and so on.

There is indisputable similarity between the working of putrid germs and of the seeds of the most virulent plagues. Fevers were classed of old as putrid diseases, and any one who has witnessed the prompt decomposition and the foul emanations of fever-stricken beings, whether human or brute, can readily understand that it was no very India-rubber-like stretch of the imagination that led our forefathers to confound contagion with putrescence.

It is, however, necessary to learn that, in practising Disinfection, we have to neutralize the products of, or check the decay of healthy matter separated from living plants or animals, and that we have likewise to destroy specific elements of contagion, elements which differ in the various maladies that are known to be transmissible from the sick to the healthy. In order to illustrate this, let us take the case of sewage. The excreta of healthy human beings decompose, and the sewer-gases belong to the class of irrespirable gases which cannot be absorbed into the system without producing serious ill effects, and even symptoms such as characterize a putrid fever—vomiting—faintness followed by prolonged stupor—fetid diarrhœa, and even death. The results are apparently undistinguishable from typhus fever. The line of demarcation, between a malignant fever produced under such circumstances and fevers due to a specific virus, has not yet been satisfactorily established.

The foregoing symptoms result also from decomposing matters passing into the blood otherwise than by the lungs, and whole hecatombs of slain, through the instrumentality of hospital gangrene, pyæmia, puerperal fever, and allied diseases, testify to the great dangers arising from the diffusion of solid or fluid matters in a state of decomposition. In dealing with the excreta of the sick, it is not the volatile elements and simple gases that we have to fear, but the materials that adhere to any thing and every thing on and around the sick, and, if ever we allow them to pass from the sick-room, it is quite impossible to control them. If we even let them pass in any quantity from room to room or house to house in atmospheric currents, we cannot trace them until they have victimized fresh subjects susceptible to their pernicious influences.

For our purpose it may be accepted as proved that successful disinfection must aim at preventing decomposition in simple putrescible matters, or must aim at attacking fever-germs as soon as discharged by the patient. It is desirable that a disinfectant should be an anti septic—viz., an agent that arrests chemical change in animal or vegetable matters, and it must be a deodorizer, or capable of fixing the most noxious gases evolved. It has been erroneously believed that

sulphuretted hydrogen is the principal deleterious gas which disinfectants have to encounter—the worst kind of vermin to ferret out. Prof. Way, however, asserts that the gaseous elements that are usually foul smelling and hurtful are ammoniacal.

The best disinfectant to deal with sulphuretted hydrogen, such as is evolved in the emptying of a foul ash-pit, would be salts of iron or chloride of zinc. Salts of iron and copper are antiseptics and very active deodorizers, and would have been used even more extensively than they have been, had they been harmless. But the iron-salts stain all they come into contact with, and copper salts are injurious to life. Zinc-salts are also inimical in this latter way. A disinfectant, to be available in the homes I am endeavoring to depict, must necessarily be harmless, and until quite recently it was not easy to find such an agent. The alkaline permanganates have been extolled as disinfectants. They are in many instances admirable deodorizers, but the fact that permanganates are sparingly soluble in water renders their employment very difficult, except in dealing with small accumulations of putrid matter. The use is too limited to enable us to rely on them for systematic disinfection.

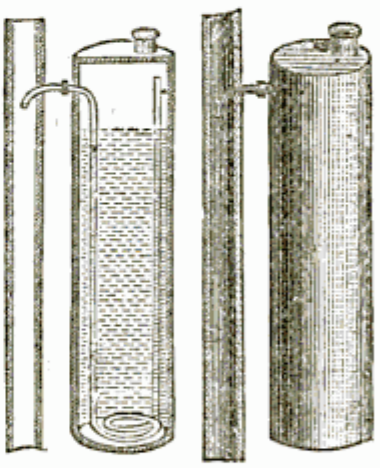
There is one volatile deodorizer and disinfectant that has been recommended very strongly in some cases by Dr. B. W. Richardson and Mr. Spencer Wells, and that is iodine. In some virulent diseases attended with fetid discharges, a little iodine placed in a box, with a little muslin to confine it, is sufficient to render the room tolerable to the attendants upon the sick. For similar purposes, peat, sea-weed, wood, or animal charcoal, have been recommended, owing to the avidity with which they condense the gases of decomposition within their pores. For some years, Prof. Gamgee has used charcoal charged with sulphurous acid as an active antiseptic, and he now suggests the use of charcoal mixed with chloride of aluminium, or, as he popularly calls it, chloralum. The sulphurous acid renders air irrespirable, but chloralum, which is a deliquescent chloride of aluminium, attracts and neutralizes the noxious elements of a poisoned atmosphere.

Having attempted to show that disinfection must be an every-day practice in the household, and that disinfectants must necessarily be harmless antiseptic deodorizers, it is not difficult to establish a code of rules of almost universal application. There is a caution that should be given at all times in a household: Servants cannot be expected to understand the use of disinfectants any more than they can be trusted to carry out a system of ventilation. Disinfection and ventilation, therefore, should, to a large extent, be automatic processes and, happily, such things are to be found.

A fusion of the two processes of disinfection and ventilation has been tried, of late, in the following manner: The space occupied by a top pane of glass is fitted up with a piece of metal which slants from the bottom upward, and the top is rounded in shape and perforated.

Inside this wedge-shaped ventilator are two shelves, pierced with holes, the top one being made to carry a box of charcoal and the bottom one a piece of sponge. By this double contrivance the inventor and patentee, Dr. Howard, of St. John's, Canada, claims not only to absorb the watery vapor of the incoming air by the sponge, and disinfect any foul air that may seek entrance by means of the charcoal, but also to warm the cold air by the amount of friction it has to undergo in its ingress through the body of a ventilator which is already somewhat heated by the warmth of the room. If the wind blows too strongly upon the outside mouth of the ventilator, Dr. Howard proposes a sliding valve to work up and down inside the pane occupied by the apparatus. I cannot but regard such a contrivance as a clumsy one. It may be said to stand in the same relationship to either perfect ventilation or perfect disinfection that spurious freemasonry does to what is called the pure craft masonry, or certain litharges to good white lead. There is no necessity, either, to filter the air of a room in such a manner.

There can, however, be a strong case made out why the water-closet pans of a house should be disinfected, and I am able to point out an apparatus which fulfils every requirement for that purpose. It is exhibited in the diagram, both in section and elevation, and is known as Brown's patent self-acting disinfector. The object is to deliver at every upheaval of the handle a certain portion of a fluid disinfectant; formerly it was exclusively Condy's fluid, now it is chloralum. The construction is the essence of simplicity. In a metal, glass, or earthenware vessel, holding a gallon of disinfecting fluid, a metal siphon is fixed, and the bottom is coiled and has a small inlet as shown, by which means the siphon fills itself. When the closet-handle is raised, the water rushing down the supply-pipe to flush the basin causes a vacuum in the disinfecting siphon, and its contents are blended with the water. By this means a portion of the deodorizing fluid is retained in the trap or basin where it has no sinecure of work to perform. The siphon refills in a few seconds, and, as only a *certain* quantity is discharged, a pint of disinfecting fluid, costing one shilling, mixed with sufficient water to make up the gallon, will serve about 140 distinct actions of the closet. The cost of the apparatus is about ten shillings, and it can be fixed in an hour to any patterned water-closet whatever. The vessel containing the fluid is usually fixed upon a bracket in a corner above the seat. This kind of apparatus can be fixed to a tap in the stable, or anywhere else, and water containing a percentage of the medicated fluid drawn off into buckets, or run off



into the pavement-drains. They can be obtained at the depot, 58 The Exchange, Southwark.

Such disinfectors are not new, but the above is the simplest. A patent automatic apparatus of a similar kind was introduced some little time ago by Mr. Spencer. It is also worked by the handle of the closet, and fixed on the wall above the seat, but it is too dependent upon a complicated action of wires and cranks—its cost is, moreover, thirty shillings. Similar contrivances are sold, adaptable for the earth-closets now in use. Whether it be true or not that the partisans of the earth-closet first drew attention to the disinfection of the excreta, I do not know, but at all events they were not far behind. I have already given an example of these as applied to the earth or ash closet. As a matter of course, they are chiefly powdered disinfectants. Mr. Bannehr, in his improved ash-closet, uses a simple carbonaceous powder, chiefly as an absorbing medium.

Nothing could be more wearisome than wading through the history of disinfectants, and yet an occasional smile would be sure to light up the way. Who would propose to burn incense to the God of Stinks at various times throughout the day, in the shape of patent pastils, composed chiefly of charcoal, sulphur, and nitrate of potass? Or who could be brought to look, Hindoo-fashion, on his patrimonial open drain or sewer as a river Ganges, and with religious punctuality set adrift upon the water there a sacred vessel which would admit a certain portion of such water, and also containing a phosphuret which would decompose in contact with the water, the gas and flame thus evolved being understood to neutralize the evaporating poison of Siva, the destroyer? And yet men have paid for leave to rivet such absurdities upon us, and the cry is, "Still they come." Since the time of M. Legras, who, in 1849, claimed to discover and patented not less than twelve disinfectants (three liquids and nine powders), what have householders not had to endure?

Apart from the many simpler disinfectants, such as earth, ashes, charcoal, peat, salt, sulphur, gypsum, alum, vinegar, and tar-water, etc., suitable for the coarser purposes of a farm, the disinfectants for the house now in commerce may be reckoned on the fingers of one hand. I have already given a general indication of the action of each, and will only add that these useful agents have now been brought to such a state of perfection, that the person who chooses to make up his own mixtures, puts himself in the position of an ague-patient, who, ignoring the labors of chemistry, prefers the powdered Peruvian bark to the sulphate of quinine.

The disinfectant used in a household ought certainly to be a non-poisonous one. Fortunately, or unfortunately, there is not any choice, for the only one of this description is chloralum, now adopted by the Board of Trade. This is the popular name bestowed upon it by its inventor, Prof. Gamgee. It contains 1,500 grains of hydrated chloride

of aluminium to the pint, or about 75 grains to the ounce, and is sold in a fluid and solid state. Slightly diluted, the former will disinfect secretions in the utensils of a sick-room; and, exposed in a saucer in its concentrated form, I have found it to remove even the smell which is given off by a newly-painted room. In its powdered state it may be sprinkled in cellars, larders, dust-bins, ash-pits, stables, piggeries, poultry-houses, and wherever a smell is continually arising. In the deodorization of sewage, while being pumped over the garden, one gallon of the fluid, or three pounds of the powder, will suffice for 150 gallons of sewage.

As regards the disinfection of clothing in the laundry, Mrs. Meredith, the patroness of the Discharged Female Prisoners' Aid Society, lately wrote to the *Standard* newspaper as under:

"The articles taken in for the wash are fairly sprinkled with chloralum-powder; they are then packed in sacks, in which they remain for about two hours, when they arrive at the wash-house. They are then unpacked and shaken singly. After this they are put in a large tank, where a great quantity of water flows over and through them. In this way they rest for at least twelve hours. They are then wrung out, and undergo the ordinary process of washing. It is highly satisfactory to add that not the least deterioration of texture or color results."

At the wash-houses referred to by this lady, a great number of women are employed, and nothing but the washing of the sick is carried on.

THE NATURAL HISTORY OF MAN.

A COURSE OF LECTURES AT THE IMPERIAL ASYLUM OF VINCENNES.

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TRANSLATED BY ELIZA A. YOUMANS.

I.—The Unity of the Human Species.

GENTLEMEN: Each of my fellow-laborers in science comes here to lecture to you; they each select the subject which habitually occupies them. Some tell you of the heavens, the earth, the waters; from others you get the history of vegetables and animals. As I am Professor of the Natural History of Man at the Museum, I ask myself why I should not speak to you of man.

There is evidently as much interest for us in our own species as in the history of animals, even of those most useful to us. Indeed, at this time, the mind is drawn toward this study by an irresistible move-

ment. Formerly, Anthropology, the natural history of man, was not represented in philosophical bodies, nor by the periodical press. Now, in Paris alone there are two Philosophical Societies occupied exclusively with this science, and two large publications equally devoted to it. At the Museum the teaching of anthropology is older. It is there aided by a collection which is still the best in the world.

I do not hesitate to say that it is one of the glories of France to have given by these methods an example to the entire world—an example followed to-day in America as well as in Europe. And I wish to make you take a part in this movement, by giving you some serious notion of the *ensemble* of the human family.

This, gentlemen, is much more difficult for me than for my associates. In all these lectures we are to speak of only a single being, man. Consequently, there will be an intimate union between them, so much so that any person who should miss a lecture would find difficulty in thoroughly understanding those that follow. To remove this difficulty, I mean to shape my teaching so that each lecture will form as definite a whole as possible. Then, at the commencement of each lecture, I shall endeavor to give, in a few words, a *résumé* of the preceding. In this way I hope to carry you to the end without ceasing to be understood.

Each lecture, then, will be a sort of chapter of what we might call *Popular Anthropology.*

By-and-by I hope that these lectures will be collected into a volume, and I shall be very proud if one day they merit the adjective I have employed—if, in reality, they become popular among you.

Let us enter, then, upon our first chapter. Since man is the subject of our discourse, we must first ask what he is. But, before answering, I ought to enter into some explanation.

This question has been often asked, but generally by theologians or by philosophers. Theologians have answered in the name of dogma and religion; philosophers in the name of metaphysics and abstraction. Let it be well understood between us that I shall take neither of these grounds, but shall avoid, with great care, both that of theology and that of philosophy. Before I became professor at the Museum, I was occupied with the study of animals—I was a naturalist. It is as a naturalist that I have taken my chair at the Institute. At the Museum I remain what I was, and nothing else. I shall continue the same at Vincennes, leaving to theologians theology, to philosophers philosophy, limiting myself in the name of science, and, above all, in the name of natural science.

Let us now return to the question I was about to put: What is man?

It is evidently useless to insist that man is neither a mineral nor a vegetable—that he is neither a stone nor a plant. But is he an animal?

No, indeed, especially *when we take into account all which exists in him.* And I am sure that in this respect you all agree with me.

Certainly none of you would wish to be compared with cattle that ruminate, with hogs that wallow in the mire. Nor would you wish to be classed with the dog, notwithstanding all the qualities which make him the friend and companion of man; nor with the horse, though it should be with Gladiator.

Man is not an animal. He is widely distinguished from animals by numerous and important characters of different sorts. I shall here only refer to his *intellectual superiority*, to which belongs articulate speech, so that each people has its special language; *writing*, which permits the reproduction of this language; *the fine arts*, by the aid of which he conveys, and, in some sort, materializes the conceptions of his imagination. But he is distinguished from all animals by two fundamental characters which pertain only to him. Man is the only one among organized and living beings who has the *abstract sentiment of good and evil;* in him alone, consequently, exists *moral sense.*

He is also alone in the belief that there will be *something after this life*, and in the recognition of a *Supreme Being*, who can influence his life for good or for evil. It is upon this double idea that the great fact of *religion* rests.

By-and-by these two questions of *morals* and *religion* will turn up again. We shall, I repeat, examine them, *not as theologians*, but simply as *naturalists.* I will only say for the present that man, everywhere, however savage he may be, shows some signs of *morality* and of *religion* that we never find among animals.

Hence man is a being apart, separated from animals by two great characters, which, I repeat, distinguish him yet more than his incontestable intellectual superiority.

But here the differences end. *So far as the body is concerned*, man is an animal, *nothing more, nothing less.* Except some differences of form and disposition, he is the equal, only the equal, of the superior animals that surround him.

If we take, for terms of comparison, the species that approach us nearest in general form, *anatomy* shows us that our organs are exactly the same as theirs. We can trace in them, almost muscle by muscle and nerve by nerve, those which we find in man himself.

Physiology, in its turn, shows us, in the body of man, the organs, muscles, nerves, performing exactly the same functions as in the animal. This is a capital fact which daily profits us, both from a purely scientific and from a practical point of view. We cannot experiment upon man—we can upon animals. *Human physiology* has employed this means to discover the functions of our organs. *Physicians* go further still; they bring to the sick-bed the fruit of experiments made upon animals. *Anthropology* also, as we have just seen, applies to these inferior creatures for very important instruction.

But Anthropology should descend much lower than the animals when it would enlighten us completely. Vegetables are not animals, any more than animals are man. But men, animals, and vegetables, are all *organized and living beings.* They are distinguished from minerals, which are neither the one nor the other, by certain general facts common to all.

All organized beings have a limited duration; all are born small and feeble; during part of their existence, all grow and strengthen, then decrease in energy and vitality, sometimes also in size; finally all die. Throughout life, all organized and living beings need nourishment. Before death, all reproduce their kind by a seed or an egg (we speak here of species, not of individuals), and this is true even of those which seem to come directly from a bud, from a layer, from a graft, etc.; for from bud to bud, from layer to layer, from graft to graft, we can rise to the seed and to the egg. Finally, then, all organized and living beings have had a father and a mother.

These grand phenomena, common to all living beings, and consequently to man, imply general laws which control them, and which must therefore govern man as well as the plant.

Science every day confirms this conclusion, which might have been reached by reason alone, but which may now be regarded as a fact of *experience.* And I believe I need not dwell here, to make you understand the magnificence of this result.

As for me, I find it admirable that man and the lowest insect, that the king of the earth and the lowliest of the mosses, are so linked together that the entire living world forms but one whole where all harmonizes in the closest mutual dependence.

From this community in certain phenomena, from this subjection to certain laws equally common, results a consequence of the highest importance. Whatever questions concerning man you may have to examine, if they touch upon any of these properties, of these phenomena common to all organized and living beings, you must interrogate not only animals, but vegetables also, if you would reach the truth.

When one of these questions is put and answered, to make the answer good, to make it true, you must bring man under all the general laws which rule other organized and living beings.

If the solution tends to make man an exception to general laws, you may affirm that it is bad and false.

But also, when you have resolved the question so as to include man in these great general laws, you may be certain that the solution is good, that it is true, and really scientific.

With these data, and these alone, we will now consider the second question of Anthropology, and here it is:

Are there several species of men, or is there but one, including several races?

To be understood, this question requires some explanation.

Look at the drawings I have hung at the bottom of the hall. These figures are part of those I employ in the course at the Jardin des Plantes.

I have brought but a small number, but they suffice to give an idea of the principal varieties which the human type presents. You have here individuals taken from nearly every part of the world; and this I regard as a very important point. You see that they differ considerably from each other in color, often also in hair, sometimes in proportions, sometimes in features.

Well, our question is, whether the differences presented by the human groups from which these designs were taken are differences of *species*, or if they indicate only differences among *races* that belong to one and the same species.

To answer this question, we must begin by getting a clear idea of what is meant by the words *species* and *race*. In fact, the whole discussion turns on these two words.

Unhappily, they have been often taken one for the other, or else they have been badly defined. The discussions which have hence arisen would very quickly cease, if we would study them a little more closely.

Let us see if we cannot get precise ideas without going into details impossible here.

Certainly none of you would ever confound an ass with a horse: not even when a horse is small, and there are horses no larger than a Newfoundland dog; nor when an ass attains the size of an ordinary horse, as, for example, our large asses of Poitou. You say immediately, they are different species: here is a big ass and a little horse. And you say the same on seeing, side by side, a dog and a wolf.

On the other hand, all of you here would give the single name of *dog* to animals which differ from each other, as do the bull-dog and water-spaniel, the greyhound and the lapdog, the Newfoundland dog and the King-Charles; and you are right.

However, judging by sight alone, even after detailed observation, you see, between the dogs I have just named, differences of size, of proportion, of color, much greater than those which separate the horse from the ass. An ass and a horse of the same size certainly resemble each other much more than the types of dog I have just named.

Further, if you place side by side a black and a white water-spaniel, you will not designate them by different names. You will call them both water-spaniels, although one is black and the other white.

In the case of vegetables you do exactly the same thing. A red rose and a white rose are equally roses; a pear is always a pear, whether you buy two for a sous in the street, or pay three francs at Chevet.

Well, without doubt, your decision is exactly like that of the

naturalists. You have answered, just as they do, the question of species and race—a question that at first appears very complicated, because of the confusion before referred to. Here, then, is one more example to prove that, under many circumstances, popular observation and good sense go straight to the mark, as well as the labors of science.

Indeed, let us translate into general scientific language what I have just said of your views, and I am very sure not to be mistaken with regard to them.

The meaning of this judgment is, that an animal or a vegetable may vary within certain limits. The dog remains a dog, whatever its general form, its size, its hair; the pear remains a pear, whatever its size, its savor, the color of its skin.

From these facts, which I simply allude to, it results that these variations may be transmitted by way of generation. You all know that the union of two water-spaniels will produce water-spaniels; that the union of two bull-dogs gives bull-dogs.

It results, finally, in a more general way, that individuals of the same species may cease to resemble each other in an absolute manner, may sometimes even take very different characters, without becoming isolated and forming different species. As we have just said, *the dog remains a dog*, whatever its modifications.

Well, these groups, formed by individuals which have departed from the primitive type, and have formed distinct secondary groups, are precisely the ones that naturalists call races.

You understand why we constantly speak of races of cattle, horses, etc. There is, in fact, but one species of domestic cattle, which has given birth to the *race bretonne*, as well as to the great cattle of Uri, with their savage aspect, and to the peaceful Durham. We have, again, but one species of domestic horse, and this species has given birth to the little Shetland pony, of which I spoke just now, and to those enormous brewers' horses that we see in the streets of London. Finally, the various races of sheep, goats, etc., have arisen from one and the same species.

We must give more precision to our ideas on this point, because the least vagueness here will make very serious inconvenience. I will cite some further examples taken from vegetables and animals, being careful to choose such as are entirely familiar.

You all know the seed of the coffee-tree. Permit me to give its history. You will see that it is instructive.

The coffee-tree came originally from Africa, where from time immemorial it has been cultivated on the declivities of Abyssinia that slope toward the Red Sea. About the fifteenth century, something like four hundred years ago, the coffee-tree crossed this sea and penetrated into Arabia, where it has since been cultivated, and whence especially we get the famous coffee of Mocha.

The use of coffee spread very early and with great rapidity in the East. It penetrated Europe much more slowly, and it was first taken in France at Marseilles.

Coffee was first drunk in Paris in 1667. The seeds which furnished it were brought in small quantity by a French traveller named Thevenot. Two years afterward, in 1669, Soliman Aga, ambassador of the Sublime Porte in the time of Louis XIV., induced the courtesans of that great king to taste it, and they found it very agreeable. However, its use did not spread for a long time. It was not until the eighteenth century that it began to be generally used.

You see that coffee has not been very long in circulation. In fact, it is scarcely a century and a half since it became an article of general consumption by the people of Europe.

Well, during many years Europe remained tributary to Arabia for this commodity. All the coffee consumed in Europe came from Arabia, and particularly from Mocha. Toward the commencement of the eighteenth century the Dutch attempted to import it into Batavia, one of their colonies in the Indian Archipelago. They succeeded very well. From Batavia some stalks were taken to Holland and put in a hot-house, where they succeeded equally well. One of these stalks was brought to France toward 1710, and was placed in the conservatory of the Jardin des Plantes, and there also it prospered and gave birth to a certain number of sprouts.

In 1720 or 1725 (I have not been able to find the precise date), an officer of the French Navy, Captain Desclieux, thought that, since Holland had cultivated coffee at Batavia, he might also acclimate it in our colonies of the Gulf of Mexico. When embarking for Martinique, he took from the Jardin des Plantes three stalks of coffee, and carried them with him. The voyage was long and difficult, by reason of contrary winds. The supply of water proving insufficient, it was necessary to put the crew on rations. Captain Desclieux, like the others, had but a small quantity of water to drink each day. He divided it with his coffee-plants. Notwithstanding all his care, two died on the passage; only one arrived safe and sound at Martinique. Put at once into the earth, it prospered so much and so well that from it have descended all the coffee-trees now spread over the Antilles and tropical America. Twenty years after, our Western colonies exported millions of pounds of coffee.

You see the coffee-tree, starting from Africa, has reached the extremity of Asia on the east and America on the west. Hence, it has nearly travelled round the world. Now, in this long voyage, coffee has become modified.

Passing by the tree, of which we know little, let us consider the seed. We need not be grocers to know the different qualities of coffees and their different production. Nobody would confound Mocha with Bourbon, Rio Janeiro with Martinique. Each of these seeds car-

ries in its form, in its proportions, in its aroma, the certificate, so to say, of its birth.

Whence came these changes? We cannot know with certainty, and explain the why and the how, and follow rigorously the filiation of cause and effect; but, considering the phenomena as a whole, it becomes evident that it is to differences of temperature, of climate, of culture, that all these modifications are due.

This example, taken from vegetables, shows that if we transport to considerable distances different specimens of the same vegetable, placing them in different conditions of cultivation, we obtain different races. Tea transported some years ago into tropical America would present us with like facts.

Take, now, an example from animals. You all know the turkey; but, perhaps, some of you do not know that it came from America. Its introduction into Europe is quite recent.

In America the turkey is wild; and there, in its natural conditions of existence, it presents many characters which distinguish it from our domesticated individuals. The wild-turkey is a very beautiful bird, of a deep-brown color, very iridescent, presenting reflections of blue, copper, and gold, which make it truly ornamental. It was because of its fine plumage that it was first introduced into France. In the beginning no one thought of the turkey as food; and the first turkey served at table in France was in 1570, at the wedding of Charles IX., two hundred and ninety-seven years ago.

As soon as one has tasted the turkey, one finds that he is too good to be merely looked at. He passes from the park to the poultry-yard, from the poultry-yard to the farm, and from one farm to another, east, west, north, and south. At present, in almost all France, turkeys are raised and are a considerable object of commerce.

But, in going from farm to farm, in travelling all over our country, this bird has encountered different conditions of existence, differences of nourishment and temperature, and never the primitive conditions that it had naturally in America. As a consequence of all this, the turkey has also varied, and, to-day, not a turkey in France resembles the wild stock. Generally, it has become much smaller; when it has preserved its deep plumage it has become darker and duller; but some have become fawn-colored, others are more or less white, and others again are spotted with white, gray, or fawn-color.

In a word, almost all the localities to which the turkey has become addicted have given birth to new varieties which have been transformed into *races*.

Now, in spite of these changes, and although they do not resemble their first parents in America, and do not resemble each other, are our French turkeys less the children of the wild-turkey of America? Or, if you like that better, are they less brothers and sisters? Have they ceased to be part of the same species? Evidently not.

What I have just said of the turkey might also be said of the rabbit. The wild-rabbit lives all around us—in our downs, in our woods—and he does not resemble, or resembles but little, our domestic rabbit. These, you know, are both great and small, with short hair, and with silky hair; that they are black and white, yellow and gray, spotted and of uniform color. In a word, this species comprehends a great number of different races, all constituting one and the same species with the wild stock which still lives around us.

From these facts, that could be multiplied, we have to draw an important consequence, to which I call your attention:

A pair of rabbits, left in a plain where they would encounter no enemies, in a few years would fill it with their descendants, and, in a little while, all France would be easily peopled. We have just seen that a single stalk of coffee gave birth to all the coffee-trees now found in America.

The wild-turkeys and their domestic offspring, the wild-rabbits and their captive descendants, may then be considered by the naturalist as equally arising from a primitive pair.

Gentlemen, this is the stamp of a species. Whenever you see a greater or less number of individuals, or groups of animals, or vegetables, if, for one reason or another, you can look upon them as descendants of a single primitive pair, you may say you have before you *a species;* if from group to group there are differences, you say these are *the races of that species.*

Observe carefully, gentlemen, that, in thus expressing myself, I have not stated for certain the existence of this primitive pair of the stock of rabbits or of the stock of turkeys. I affirm no such thing, because neither experiment nor observation—the two guides we should always follow in science—can aid us on this point. I only say to you, every thing is as if they had been derived from a single pair.

You see, after all, the question of *species* and of *race* is not very difficult to comprehend, nor even very difficult to settle when we know the wild type, when we have the historic data which enable us to connect with this type the more or less different groups which domestication has detached. But when we do not know the wild type, when the historic data are lost, the question, on the contrary, becomes extremely difficult at the first step, because differences that we encounter from individual to individual, and, above all, from group to group, might be considered as specific differences.

Happily, Physiology comes now to our relief. We encounter here one of those great and beautiful general laws upon which the established order depends, and which we admire more the more we study. This is the law of cross-breeding—a law which governs animals as well as vegetables, and is, of course, applicable to man himself.

You know what is meant by the word crossing. We mean by it all marriage occurring between animals that belong either to two

different species or to two different races. Well, the results of these marriages obey the following laws, which are:

When this union takes place between two animals belonging to *different species*—that is, when we attempt *hybridization*—in the immense majority of cases the marriage is *sterile*. Thus, for example, it has been tried thousands of times and in all the world, to unite *rabbits* and *hares*. It is said that they have succeeded twice. But these two quoted facts are much more doubtful than the results of experiments recently made by a man of true talent, skilled in the art of experimenting, and who believes in the possibility of these unions, who has completely failed. Although he furnished the best conditions for success, he was not more fortunate in his results than Buffon, and the two Geoffroy Saint-Hilaires before him.

So the rabbit and the hare are of such a nature that, although presenting in appearance a great conformity, they cannot reproduce together.

Such is the general result of crossing two different *species*.

In many cases, the union of two individuals of different species is fertile, but the offspring cannot reproduce. For example, I refer you to the union of the ass and horse. This union produces the mule. All the mules in the world are offspring of the jackass and the mare. Now, these animals are numerous, for in Spain and in tropical America they are much preferred for work to horses, because of their resistance to fatigue. The *hinny*, less in demand, because less robust than the mule, is the result of an inverse cross; it is the offspring of the horse and the ass. The hinny, like the mule, cannot reproduce its kind. When we wish for either, we must have recourse to the two *species*.

Finally, in extremely rare exceptions, the fertility persists in the offspring, but it is much diminished. It diminishes still more in the grandchildren, and it is extinguished in the third or fourth generation at the most. This is the case when we unite the canary-bird with the goldfinch.

I might here accumulate a mass of analogous facts and details. But over them all would appear a great general fact including them, which is the expression of a law; and here is this fact: notwithstanding observations reaching back for thousands of years, and made on hundreds of species, we do not yet know a single example of intermediate species obtained by the crossing of animals *belonging to different species*.

This general fact explains how order is maintained in the present living creation. If it had been otherwise, the animal world and the vegetable world would be filled with intermediate groups, passing into each other by insensible shades, and, in the midst of this confusion, it would be impossible for even naturalists to discriminate.

The general conclusion from all this is, that *infertility is the law when animals of different species unite* (HYBRIDIZATION).

When, on the contrary, individuals which are only of *different races*, but of the same species, are brought together, that is to say, when we produce a *mongrel*, is the result the same? No, it is exactly contrary.

These crossings are always fertile, and sometimes more so than the union of animals of the same race. But especially the children and grandchildren are also as fertile as the parents and grandparents; so much so that they propagate their kind indefinitely. The difficulty here is not to procure *mixed races;* the difficulty is, when we have pure races that we desire to preserve, to keep strange blood from modifying them.

Races thrive by crossing—that is, by the union of different races of the same species, they multiply abundantly around us; such are our street-dogs, our roof-cats, our coach-horses, all our animals where the race is indistinct; because of cross-breeding in all directions, the differential characters becoming confounded.

So far from experiencing difficulty in obtaining offspring from races, the men who are occupied with cattle, with sheep, with horses, amateurs in dogs, in pigeons, know with what watchful care they must protect their favorite race.

Here, then, is a general fact, and from this fact it results that *fertility is the law of union between animals belonging to different races* (MIXED BREEDING).

Here, gentlemen, you see the great distinction, the fundamental distinction, between *species* and *race.* And, it is all the more important to recognize and record this distinction, as it facilitates experiment. When you have two different vegetables, or two different animals, and wish to know whether they belong to two *distinct species*, or only to *two races of the same species*, marry them. If the union proves immediately fertile, if the fertility is propagated and persists, you may affirm that, notwithstanding the differences which separate them, these vegetables and these animals are only *races of the same species.* If, on the contrary, you see the fertility disappear completely or diminish notably at the first union, if you see it decreasing, and go on diminishing, to disappear at the end of a few generations, you may without hesitation affirm that these vegetables and these animals belong to *distinct species.*

Gentlemen, I have discoursed at length of vegetables and animals, of the coffee-tree, of the turkey, of the rabbit, of the dog, of the cat, of cattle, etc., and you may think that I am forgetting man. On the contrary, I have not ceased to think of him.

What is our question concerning man? Distinctly this.

Look once more at these designs. They show you differences, marked enough, between the human groups, although less considerable than at first appears.

Now, we do not know the type or the primitive types of these human groups.

Even when we encounter one or several men, presenting the characters of these types, we cannot identify them, for lack of historical documents upon the subject. Consequently, if we judge by the looks, if we take account only of the men themselves, we cannot decide whether the differences they present are *differences of race or differences of species;* whether man is to be considered as arising from a single primitive stock, or whether we ought to suppose several primitive stocks.

But we have already said, and we again repeat, that *man is an organized and living being;* and, as such, he obeys all the general laws which govern all organized and living beings: he consequently obeys the laws of crossing. These, then, we must interrogate, to find out whether there *is one or several species of men.*

Take, for example, the two most distinct types, those which, more than any others, seem separated by profound differences—the white man and the negro.

If these types really constitute *distinct species*, their union ought to bear the stamp we have found to characterize the unions between animals and vegetables of different species. In the great majority of cases they should be infertile; in all the remainder, slightly fertile; the fertility should soon disappear, and they should not be able to form intermediate groups between the negro and the white. If these two men are only *races of one and the same species*, their union, on the contrary, should be very fertile; the fertility should be kept up by their descendants, and intermediate races ought to be formed.

Well, gentlemen, the facts here are decisive, and admit of no hesitation. It is scarcely three centuries since the white man *par excellence*—the European—made, so to say, the conquest of the world; he has gone everywhere, and everywhere he has found local races, human groups that do not resemble him; everywhere he has crossed with them, and the unions have been very fertile, sometimes very sensibly more fertile than those of the indigenous people themselves.

And further, in consequence of a detestable institution, which happily has never sullied the soil of France, in consequence of slavery, the white has taken the negro everywhere, everywhere he has crossed with his slaves, and everywhere a mulatto population has been formed. Everywhere, also, the negro has crossed with the local groups, and everywhere there have sprung up intermediate races, which, by their characters, proclaim this double origin. The white, finally, has crossed with these mixed breeds, and hence has resulted in certain parts of the globe, and notably in America, an inextricable mass of mixed peoples, perfectly comparable with our street-dogs and roof-cats.

The rapidity with which these mixed races cross and multiply is truly remarkable. It is hardly three centuries, about twelve genera-

tions, since the European spread over all parts of the world. Well, we estimate that already one-seventieth of the total population of the globe are mixtures, resulting from the cross of the whites with indigenous peoples.

In certain states of South America where the mixture began earlier, where the European arrived in the first days of discovery, a quarter of the population is composed of cross-breeds, and in some regions the proportion is more than half.

You see, our experience is to-day as complete as possible. Unless we deny all modern science, unless we would make man a solitary exception in the midst of organic and living beings, we must admit that all men form only one and the same species, composed of a certain number of different races; we must, therefore, admit that all men may be considered as descended from a single primitive pair.

You see, gentlemen, we have reached this conclusion, outside of all species of dogmatic or theological consideration, outside of all species of philosophical or metaphysical consideration. Observation and experiment alone, applied to the animal and vegetable kingdom, science, in a word, leads us logically to this conclusion: *there exists but one species of men.*

This result, I do not fear to say, is of great and serious importance, for it gives to the thought of universal brotherhood the only foundation that many people now recognize, that of science and reason.

I hope, gentlemen, that my demonstration has convinced you. However, I am not unaware of the fact, and you doubtless also know, that all anthropologists are not agreed. There are among my fellow-laborers a certain number of men, even of great men, who believe in the plurality of the human species. Perhaps you may have come in contact with them. Well, listen, then, with attention to the reasons they bring in support of their view. You easily see that all these reasons may be summed up in this: There is too much difference between the negro and the white man to permit them to belong to the same species.

Then you reply: Between the white or black water-spaniel and the greyhound, between the bull-dog and the lapdog, there is much more difference than between the European and the inhabitant of Africa, and yet the greyhound and the water-spaniel, the bull-dog and the lapdog, are equally dogs.

They will perhaps add: How could the same primitive man, whatever his characters might be, give birth to the white man and the negro?

You will answer: How has the wild-turkey, of which we know the origin, of which we know the grandparents, how has the wild-rabbit, which we find still among us, how have they been able to give birth to all our domestic races?

We cannot, I repeat, explain rigorously the how and the why; but

this we know, the fact exists, and we find its general explanation in the conditions of existence, in the conditions of the environment.

Now, man, who has progressed upon the earth a much longer time than the turkey or the rabbit, who has been upon the globe for thousands of years, living under the most diverse, the most opposite conditions, multiplying further the causes of modification by his manners, his habits, his kind of life, by the more or less care he takes of himself —man, I say, is certainly found in conditions of variation much more marked than those which have been encountered by the animals we have cited. It is not, then, surprising that men, from one group to another, present differences of which we here see the specimens. If there is any thing in them to astonish us, it is that these differences are not more considerable.

In your turn you ask of the polygenesists—for this is the name given to the philosophers who believe in the multiplicity of the human species—how is it that when the white man comes to any country whatever, at the antipodes, in America, in Polynesia—how is it, I say, that everywhere he crosses with human groups that differ most completely from him; that these unions are always fertile, and that everywhere he has left traces of his passage in producing a mixed population?

If you press your interlocutor a little, he will quite often deny the reality of species; he will thus put himself in contradiction with all naturalists without exception, botanists or zoologists—with all the eminent minds who, following Buffon, Tournefort, Jussieu, Cuvier, Geoffroy Saint-Hilaire, have studied vegetables and animals, outside of all discussion, and without thought of man.

In thus dealing with the question, the polygenesist falls into disagreement with the best-established science.

Sometimes, also, you will hear him declare that man is an exception, that he has his particular laws, that the arguments taken from plants and animals are not applicable to him. Answer him, then, in the name of physiology, in the name of all the natural sciences, that he is certainly mistaken.

It is quite as impossible that an organized and living body should escape the laws of organization and life as that material substances should escape the laws that govern inorganic matter. Therefore, man, an organized and living being, obeys, as such, all general laws, and those of crossing like the rest. The conclusion we have drawn is then legitimate, and the nature of the arguments employed to combat it is a further proof in its favor.

Gentlemen, the subject of this lecture, which has occupied about an hour, at the Museum took up an entire course. The exposition has necessarily been brief. But I hope you have seen reasons strong enough to make you accept my view.

If doubts remain, try to come to my lectures. Some of you will be able, perhaps. I sometimes see working-men on the seats of my lec-

ture-room, and I can testify to the attention of some among them. I own I was happy to see the attention they gave to these exalted questions. It would give me great pleasure to see at the Jardin des Plantes some of my audience at Vincennes.

THE CAUSES OF DYSPEPSIA.

By ARTHUR LEARED, M. D.

THE digestive power may be compared to the physical strength. Every individual can without inconvenience carry a certain weight, while any addition to it is accompanied by a proportionate sense of oppression. In the same way, what is called indigestion is often simply a result of excess. The amount of food which each man is capable of digesting with ease has always a limit. This limit bears relation to his age, constitution, state of health, and habits.

For undisturbed digestion two conditions are essential: a proper relation of the aliment to the digestive organs, and a healthy state of the organs themselves. The first is generally within direct control; but, obviously, with the second, this is not the case; and when, as frequently happens, both conditions are imperfectly fulfilled in the same person, more or less dyspepsia ensues.

Bearing in mind these general views, let us examine the influence of particular causes; and first, as regards age. Appetite, or the natural feeling that food is wanted, indicates that the waste of the body requires to be replenished—that the outlay begins to exceed the income. From birth to the moment of dissolution, waste and supply are in active operation. The infant, in consequence of its rapid growth, requires food at short intervals, and the energy of the wasting process is shown by the activity of his excreting organs. So long as growth continues, the same conditions may be observed, but in a lessening degree. When the stature and form of the body are matured, the demands for nutrition are less urgent, and, after middle age, are diminished still more. The practical inference is, that the man of advanced years does not require, and should not take, as much food as the young man.

How this was recognized by a profound thinker, may be read in Cicero's "Essay on Old Age." He expresses himself gratefully that, while advancing years increased his desire for conversation, they had diminished the necessity for food and drink. But such reflections are seldom made, and still more rarely acted upon. At all stages of adult life, but particularly during its decline, the appetite is over-stimulated

by condiments, and tempted to excess by culinary refinements.[1] Dyspepsia is not the worst result of this. Gout, and still more serious maladies connected with an impure state of blood, closely follow.

Infringements of the laws of digestion are constantly and in many instances unconsciously committed. One man digests with ease an amount of food which would be fatal to the comfort of another. Animal food is easily digested by some persons twice, or even three times daily; while, if taken by others more than once, it is sure to induce suffering. Nevertheless, the diet of persons associated together is apt to be the same, and a sufficient individuality in matters of eating and drinking is seldom observed.

When the general health is impaired from any cause, digestion infallibly suffers. In many instances it is sought to prop up the one by overtaxing the powers of the other, and dyspepsia is often thus permanently added to the old disorder. The proverb, "Custom is second nature," applies to the human constitution. Health may be maintained, by gradual usage, under circumstances which would be disastrous to the novice. In this country, great faults are committed in the relative amount and distribution of meals. Breakfast frequently consists of tea or coffee, with a small proportion of plain bread or toast. This allays the appetite, but is insufficient for the supply of bodily waste during the long interval between breakfast and a late dinner; during which, in many instances, no luncheon is taken. It also often happens that no solid food is taken from dinner-time until the following morning, which is an additional reason for a more substantial breakfast.

Experience shows that the delicate stomach suffers severely from these causes. In some instances, the long-unemployed organ secretes an excess of mucus, which greatly interferes with digestion. A sufficient amount of food at breakfast has a direct influence on the digestion of dinner; in which process, large quantities of gastric juice—a fluid charged with nitrogenous and other materials—must be suddenly extracted from the blood. No argument is needed to prove that the blood will be better fitted for these demands upon it, if replenished by the absorption of a substantial breakfast. If gastric juice, insufficient in quantity or of bad quality, be supplied, the appetite for dinner exceeds the digestive power, and another material cause of dyspepsia arises. Long abstinence thus causes the amount of food taken at dinner to be relatively, as well as absolutely, in excess. When a sufficient quantity of nutriment has been taken in the morning, less will be requisite at a later period, and less will be desired.

The distribution of meals in point of time is by many regarded as quite unimportant. Dinner, as has been said, comes late, quickly followed by tea, and sometimes by supper also. This approximation

[1] Abernethy, in his peculiar style, insists that civilized man "eats and drinks an enormous deal more than is necessary for his wants or welfare. He fills his stomach and bowels with food which actually putrefies in those organs."

of meals is pernicious, for the human stomach was unquestionably intended to have intervals of rest. The organ should be allowed to act on its contents *en masse;* to eat constantly like a ruminant animal is altogether unnatural. The health of any individual would speedily break down, were even the proper amount of food taken in equally divided portions at very short intervals.

Continual alteration of the time of meals is another great mistake. Every hour of the day for dinner, from one to eight, will sometimes be ranged through in the course of a single week. Such irregularities may long be endured by the robust stomach, but are very injurious to the weakened organ. In relation to time, all our functions are singularly influenced by habit. Digestion, therefore, will be best performed at the period when the stomach, from habit, expects employment. The kind and quality of food are essential considerations; and these subjects will be considered elsewhere. Adulteration of food is without doubt a cause of dyspepsia. Inferior articles of diet, such as tough meat or coarse fish, may, in those unaccustomed to them, produce serious inconvenience; and the impurities of water are well known to disorder digestion.

Man inhabits every part of the globe where external influences can be successfully resisted, and, in effecting this, food is an important element. The colder the climate the more animal food and oily substances are requisite; the warmer, the more vegetable diet is suitable. Whale-blubber to the warmly-clothed Esquimaux, and rice to the naked Negro, are not more necessities of locality than they would be matters of choice. The same indications exist even within European limits. Thus, diet in England and in Italy is essentially different.

The effects of universal communication are nowhere more obvious than on the luxurious table. To furnish the refined *cuisine*, all climates, both sea and land, are laid under contribution; and the stomach is expected to digest every thing that is put into it. Huddling together such various products, and neglect of the relation between climate and food, are active causes of dyspepsia. The substantial dishes of this country accord badly with the thermometer at ninety degrees; thus, among the English in India, inflexibility in regulating the kind and quantity of food taken is the cause of much ill health.

Under the head of the relation of food to the organs may be placed the effects of insufficient mastication. It is a fruitful source of dyspepsia, and is more frequently caused by haste or carelessness, than inevitable from the want of teeth. The great prevalence of dyspepsia in the United States has been attributed to the rapid and characteristic manner in which meals are there dispatched. In some employments the insufficient time allowed for meals is, for the same reason, a cause of disturbed digestion, and too often gives rise to permanent disease. Besides actual loss, soreness of the teeth or of the gums, sometimes attended by fetid secretions, greatly interferes with mastica-

tion. It is most important that solid food should be duly prepared, by chewing, for the action of the stomach; and it is also important that the starchy elements of food be sufficiently submitted to the action of pure saliva.

There are numerous other causes which affect the digestive organs less directly, but no less injuriously. It has been assumed by some writers that the conditions of civilization are incompatible with the highest degree of health. But there is every reason to believe that dyspepsia affects all races. The Laplander is especially subject to water-brash; the Maories of New Zealand suffer much from dyspepsia; and the use of bitter substances to promote digestion is known to many savage tribes. The extremes of abstinence and repletion common with savages, their precarious mode of existence, their fits of complete indolence, followed by exhausting fatigue, must cause them a full share of digestive trouble.

The relative superiority in physical strength of civilized over savage nations has been sufficiently proved. Refined and settled habits are not *necessarily* attended by any physical disadvantages. But it is observable that those who live in towns are most affected by dyspepsia. There it is that the mental powers are most overtasked; and the relation between mind and body, as well as their mutual reactions, disregarded or forgotten. Too large a share of the nervous energy, so necessary for digestion, is expended in mental toil or business anxieties. In many cases, attention to the commonest physical wants is neglected in monotonous pursuits; the appetite for food is disregarded until it no longer exists; exercise is either not taken at all, or is fitful and unseasonable; ventilation is neglected, and a close and polluted atmosphere is breathed. Such is no overdrawn picture of the town life of vast numbers who suffer, more or less, from dyspepsia.

Two habits, smoking and taking snuff, require special notice as causes of dyspepsia. Excessive smoking produces a depressed condition of the system, and a great waste of saliva if the habit of spitting is encouraged. I have met some severe cases of dyspepsia clearly resulting from these causes. Some individuals are unable to acquire the habit of smoking even moderately. Deadly paleness, nausea, vomiting, intermittency of pulse, with great depression of the circulation, come on whenever it is attempted. But this incapacity is exceptional, and so universal is the desire for tobacco, that it seems as if some want of the system is supplied by its use. Smoking has been attacked and defended with much zeal. Its adversaries have strongly urged that the practice is a potent cause of dyspepsia. The late Sir Benjamin Brodie was a great enemy to tobacco. But, as one of his biographers has observed, he appeared in this instance to have departed from the rule by which he was generally guided, to weigh impartially all the facts bearing on an argument. Other names of eminence might be cited in the ranks of those who are strong opponents of smoking. On

the other hand, tobacco stands in no want of facts or of able advocates in its favor.

It has been proved, beyond question, that, where men have been exposed to the combined influences of cold and want of food, those who smoked displayed most endurance. Dr. Hammond states that smoking in moderation, if the food be at the same time sufficient, increases the weight of the body.[1] The author of a clever work on physiology states that a cigar after dinner notably assists his digestion.[2] I am often told by patients that the sense of oppression felt after meals is relieved by smoking. The explanation depends on the strong sympathy which exists between the stomach and the salivary glands. One proof of this dependence is that sickness of stomach is commonly attended by salivation. This makes it probable that, when the salivary glands are stimulated by smoking, the gastric glands, in obedience to a sympathetic action, pour out their secretion more freely. But, if a depressing effect on the nervous system is induced by smoking too much, digestion is certain to be impeded. On the whole, smoking is the cause of more harm than good to digestion. That kind of chronic nervous depression which belongs to hard and inveterate smokers is always accompanied by dyspepsia.

The effects of taking snuff are more insidious, as no warning is given by immediate bad consequences. Great snuff-takers are often sufferers in the stomach. In addition to the specific effects of tobacco, the continued stimulating and mechanical action of snuff on the mucous membrane of the nose is injurious. Irritation is directly transmitted from the nasal surface to that of the stomach, with which it is continuous. Dry snuffs are more hurtful than moist, as they penetrate farther.

The difficulty of breaking off or even moderating this habit is well known, and the following plan, practised with success by an inveterate snuff-taker, is worth mention: Instead of pure snuff, he kept in his box a mixture in equal parts of snuff and powdered valerian-root. His theory was, that the valerian repaired the ravages of the snuff upon his nerves, but the more probable explanation of the benefit is, that he consumed much less of the disagreeable compound than he did of pure snuff.

Persons engaged in offices are exposed to a directly-exciting cause of indigestion. The stooping posture in which they write, mechanically interferes with the stomach's action. I have even traced well-marked dyspepsia to sitting immediately after dinner in a low arm-chair, so that the body was curved forward and the stomach compressed. In some trades, the pressure of certain implements upon the pit of the stomach, as in the case of curriers, bootmakers, and weavers, produces severe dyspepsia. Many bad cases, attended with water-brash, occur among the weavers of Spitalfields.

[1] "Physiological Memoirs." By W. Hammond, M. D. Philadelphia, 1863.

[2] "The Physiology of Common Life." By G. H. Lewes, M. D.

Self-indulgent, luxurious habits, are highly injurious to healthy digestion; but on this threadbare subject it would be mere waste of time to enlarge. Idleness, and the want of a definite pursuit in life, must also rank high in this class of causes. To preserve the general health, occupation is as necessary for the active mind as exercise is for the vigorous body.

The importance in the system of the reproductive functions is such that their exhaustion must, sooner or later, react on the functions of nutrition. Lamentable instances of the results of sexual excess are occasionally met, and dyspepsia is almost invariably one of these. But the injurious effects of a free indulgence of the sexual instincts have been highly colored. Unprincipled men, who prey on the young and the inexperienced, magnify and distort the significance of certain ailments, the treatment of which, in too many instances, passes out of the hands of the regular practitioner.

In youth, the sensations are quickest, and the impressions most fresh and vivid; so that it might be supposed life would be always then most keenly enjoyed. But its earlier years are frequently clouded. An aching desire for change and excitement often destroys present happiness; and, when the desired excitement is unattainable, *ennui* and a hopeless indolence ensue. Experience convinces me that this condition of mind is but a frequent result of a feeble state of health. This can be often traced to an overstrain of the mental powers—a strain daily increased among men by a spirit of emulation, fostered and rewarded by the competitive system to an extent formerly unknown. Accomplishments also among girls are made objects of relentless perseverance. In both sexes, at a time when growth is incomplete, and new functions are springing into existence, the mental are developed at the expense of the bodily powers. Nutrition suffers because appetite and digestion are impaired, and the power of the mind itself is weakened. Over-exertion of mind fatigues equally with that of the body. No reasonable doubt can therefore be entertained that *thinking* is the result of a physical action in the brain. In what may be for convenience termed secretion of thought, demands are made on nutrition just as in bodily exercise. It has been often observed that great *thinkers*, if healthy, are usually large *eaters*.

The state of the air we breathe is highly important in relation to dyspepsia. We live at the bottom of an elastic medium, presenting everywhere the same general composition, and exactly adapted to the exigencies of animal life. Any accidental impurity of the atmosphere tends to disturb the balance of health. Oxygenation of blood is the object of respiration; and its replenishment is the object of digestion. On the other hand, the digestive secretions, as well as the nervous energy by which they are governed, depend for their perfection upon the perfect state of the blood. For this reason ill-ventilated workshops and crowded sleeping-rooms among the poor, and the overheated and

impure atmosphere of assemblies and public places of amusement among the better classes, are constantly-acting causes of dyspepsia.

Many invalids are affected by changes of weather, especially if these changes occur suddenly. Even in the healthy a general feeling of discomfort is caused by easterly winds; and various disorders are greatly aggravated by them. Rheumatic patients are especially susceptible of bad effects from damp or cold winds, and many dyspeptics are hardly less so; an unusually dry atmosphere is equally injurious to others.

As in the case of a change of climate, the quantity and kind of food required are much influenced by season and temperature, and the agency of these in causing dyspepsia is, therefore, not to be wondered at. Some dyspeptics are always better in summer than in autumn or winter, others the reverse; while a great many tell us they suffer more in spring than at any other season.

Our bodies are at all times pervaded by electricity, the condition of which often completely changes. The clear, serene atmosphere is usually charged with positive electricity, and this, by induction, causes our bodies, as well as the earth itself, to be negative. In wet or stormy weather the opposite of this state of things is usual; the atmosphere is negative while our bodies are positive. We are unable in health to detect these electrical changes; but we might reasonably look for their effects when disease had rendered the body less capable of resisting external impressions. The probable effects of electricity, when the health is susceptible, will be again referred to.

We have still to consider instances in which, although the food may be suitable, and the digestive organs healthy, dyspepsia may be induced by an immediate and accidental effect upon the organs, through the influence of the nerves. There are certain sensations, of which nausea is a remarkable instance, not obviously assignable to any of the five senses; and all these sensations seem capable of being excited by mental influence. We are all conscious that the stomach is a region of sympathy; and here Van Helmont places the seat of the soul itself. With the stomach, or with the bowels, easily confounded with it, various passions—as joy, sorrow, compassion, and indignation—have been in all times associated.

It is universally known that bad news received at or preceding a meal will spoil the best appetite. A disagreeable mental impression sometimes even produces severe dyspepsia, with epigastric pain and sense of oppression, nausea, or vomiting. The intimate nervous connection between the stomach and the brain leaves us at no loss to explain this; and probably an arrest of the secretion of gastric juice is the immediate cause; for in the same way the mouth will become dry from a diminished secretion of saliva. Dyspepsia is also produced or aggravated by severe mental exertion immediately after meals, because of the untimely expenditure of nervous power.

Violent bodily exercise when the stomach is full is a well-known cause of disturbed digestion; and in this case the disturbance seems mechanical. The motions of the stomach cannot be favorably carried on while its contents are tossed about by rapid movements of the body; for we know it is essential to the due solution of food that it should be all in turn brought into contact with the stomach's surface

A cold bath after a full meal will frequently disturb digestion; and a hot bath either of water or air will do so with still more certainty. Dyspepsia from warm and cold bathing occurs, in each case, on the same principle, but for opposite reasons. It has been proved, from observations on Alexis St. Martin, that congestion of the stomach is most unfavorable to the secretion of gastric juice. Now, the shock of cold bathing produces congestion, by driving the blood from the surface of the body to the viscera; on the other hand, a certain flow of blood to the stomach is equally indispensable, and *that* would be interfered with by the hot bath, because it draws the blood from the viscera to the surface. Free bloodletting soon after a meal is commonly succeeded by vomiting, and this affords another example of the effect of sudden withdrawal of blood from the digestive organs.

Dyspepsia has the widest range of all diseases because it forms a part of almost every other; and some, as pulmonary consumption, are in many instances preceded by it. In such cases, early attention to the defects of nutrition would often avert a fatal issue. The gravest forms of dyspepsia accompany organic changes in the alimentary tube itself, as cancer and ulcer of the stomach. It cannot be affirmed that simple dyspepsia does not sometimes shorten life, by producing another disease, or even prove fatal of itself; yet it is certain that digestion may be performed with difficulty for many years without more serious results than proverbial suffering and discomfort.—*Causes and Treatment of Imperfect Digestion, new edition.*

WOMAN AND POLITICAL POWER.

By LUKE OWEN PIKE, M. A.,
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IT is not improbable that the present remarkable phase in woman's history may have made its appearance, partly at least, through reaction against the very common opinion that the male is the superior sex. This idea, offensive as it is to all feminine sentiment, receives its best illustration in the old fable, according to which, various parts of the body, each being necessary to the rest, put in a claim, each, to superiority. The truth is that in the sexes, as in the members, there

is neither superiority nor inferiority; but it does not therefore follow, as has been hastily assumed, that there is equality. No two things can be pronounced equal or unequal, superior or inferior, unless there is some common standard by which they can be measured. The color *blue* is not equal nor inferior, nor superior to the color *yellow;* and the *green*, which is produced by the mixture of the two, owes no more to one than to the other. In the same way, humanity is perpetuated by the coexistence of male and female; and, if the functions of either one sex or other were radically changed or perverted, humanity itself would cease to exist.

The most vital point in my present argument is that woman must be regarded as woman, not as a nondescript animal, with a greater or less capacity for assimilation to man. The question, regarded from a scientific point of view, is not how far the female intellect can be trained to imitate the male; but what it may be shown to be from observation, or inferred to be from correlations of physical structure. The argument, from observation, which would be considered sufficient by most men of science, is controverted on the ground that human laws have been stronger than the laws of Nature. It is said that man has oppressed woman by his superior muscular power, and has impeded the natural development of her intellect. If this be true, and if mere strength of body can thus get the better of mind, it is certainly strange that horses and elephants have not become the masters of men; and hardly less strange that the stalwart Negro should long have been the slave of the more intellectual, but not more muscular, white man. But, as it is useless to prove the relations which have existed, to those who preach of relations which ought to exist, between the two sexes, it becomes necessary to investigate the matter from the point of view of physical structure and its correlated functions.

Among other and better-known features distinguishing the female sex from the male, are the smallness of the brain-case, the width of the pelvis, and the tendency to deposit adipose tissue, rather than muscular fibre. To the rule, of course, there are exceptions; there are masculine women just as there are effeminate men, and those exceptions I propose to consider before concluding, but they ought not to affect the broad general treatment of the subject. To these and other differences of structure, correspond numerous differences of function. Both the capacity and the desire for muscular exertion are less in the female than in the male; the strength of the system develops itself in another direction. So also the desire, if not the capacity, for the prolonged study of abstruse subjects, is less in the female than in the male; and mental activity pursues another course. It does not follow that, because a man can lift a greater weight on the average than a woman, he is therefore her superior, any more than that he is her inferior because she can bear children and he cannot. Nor is

woman man's inferior because she has never devised a system of philosophy, any more than she is his superior because he lacks all her wealth of maternal tenderness, and some of her ready powers of expression.

Much has been said of the difference of weight in the male and female brain; and it has been argued that the female intellect must, for that reason, be necessarily inferior to the male. But apart, from the difficulty of finding a common measure for the two, there is great uncertainty concerning the relation of mental activity to the contents of the skull. The average stature of women is less than that of men; and therefore the absolute difference of weight cannot be a fact of any value, unless the various mental functions are localized. He would be a very bold man who ventured to pronounce that the brain has no influence over the muscles of voluntary motion, or even over those which are beyond the control of volition. And when inferior stature is found in combination with less development of the muscular system, who can say how far these conditions may be the correlates of some condition of the brain? It may be, and probably is, true that the brain is intimately connected with intellectual and emotional manifestations; but it is probably no less true that the brain is connected with all manifestations of volition; and, until we have determined the relative position and the quantity of cerebral matter necessary for combined muscular movements, we have no means of determining the quantity or the position of that which is necessary for thought and feeling. I am aware that many attempts to localize the various functions have already been made; but the mere fact, that the various inquirers and experimenters have arrived at various and contradictory conclusions, is in itself enough to prove that the contents of the skull have not yet been correctly mapped.

Women of all nations are, I believe, generally considered to possess not only more emotional characters, but greater powers of observation than men. If this be true, it follows, I think, that their senses must be more strongly developed than those of the male sex, and that their memories must be equally if not more retentive. It matters little that the objects which they observe are not the objects observed by men. It is as great an effort for the eyes and mind to see and remember all the colors and all the forms in a room full of human beings, as to define the position of the earth's strata, and assign every fossil to its place. But women, on the average, prefer millinery to geology, and men, on the average, applaud the preference. The matters with which attention is occupied must, to a great extent, depend upon the bodily capabilities of each individual. The man who has lost his limbs cannot scale mountains, and the blind man cannot paint; but the energies of either may flow in a direction suitable to his circumstances, and each may distinguish himself in some field of thought.

And so, although woman may be more at home in the drawing-room or the nursery, than in the field of battle or the seventh heaven of metaphysics, her walk in life may exhibit qualities as high, and energies as well directed, as those of the chemist, the engineer, the philologist, or even the philosopher. Nothing can be more ungenerous than to flout her with her domestic cares, or to depreciate her efforts to please. If her form is more susceptible of adornment than man's, it is but natural that she should be more anxious to adorn it. If it is a privilege of her organization that she can become a mother, the wish to deprive her of it is not consistent with the teachings of science, with manliness of character, or with common-sense. If her maternity forces upon her the consideration of minute details which are unobserved by men, or have no interest for them, the tendencies of her mind are not a fit subject for detraction, unless that detraction be intended, as it commonly is, for maternity itself.

The *elements* of the female mind (to regard the mind alone, for a moment) are probably, as the champions of women's rights assert, identical with those of the male; and the inference which some persons would draw is that the *mind itself* ought not to be different. No one would seriously deny that woman possesses emotions, will, senses, and intellect; or that man's mind is susceptible of precisely the same division. It does not, however, require even a knowledge of chemistry to discover that combinations of the same elements, in different proportions, will produce compounds of different qualities. But chemistry, perhaps, illustrates the subject better than any other science. Not only may the same elements, mingled in different quantities, produce substances of different properties; but the same elements, even in the same proportions, may, under different circumstances, yield dissimilar products. Not only do the ethers differ from the alcohols, and each alcohol and each ether from its namesake, though all are compounded of carbon, hydrogen, and oxygen, in different proportions; but alanine and sarcosine — which are both compounded of carbon, hydrogen, nitrogen, and oxygen, in exactly the same proportions—have properties entirely different from each other. If, therefore, it could be shown that the male and female minds are, in the language of chemistry, isomeric, it would not follow, according to any natural law, that they should be identical in character; still less if they merely possess the same elements without being isomeric. And it would surely be not more unscientific to preach the conversion of all ether into alcohol, and all sarcosine into alanine, than to insist that the feminine mind should undertake all the functions of the male.

While the senses, and the faculty of retaining impressions, are as strong in women as in men, and perhaps stronger, it will hardly be denied that in all ages and in all climates women are and have been more prone to the display of emotion than of pure reason. Rachel

weeping for her children, Sappho burning with desire, Iphigenia grieving, not to die, but to die unwedded, Aspasia brilliant with wit and cruel in hate, the girl who, as Horace says, lied gloriously to save her lover, the woman prodigal of her ointment upon the Saviour's head, Cleopatra, too proud to live when she could not captivate her conqueror, are immortal types of what is good and what may be bad in feminine nature. It is not out of such qualities that statesmanship can be developed or science advanced; but science and statesmanship are not the only good things in the world, and the world may enjoy enough of them without calling in the assistance of women. If man's highest prerogative is to think, woman's noblest function is to love; and this assertion is not a metaphysical dogma, nor even a generalization from the history of mankind, but is an inference from the relative position of the sexes throughout the whole of that class of animals to which mankind belongs. The maternal instinct, as it is commonly called, is shared by the females of all the mammalia, from the tigress to the gorilla, and is not, as might be inferred from certain teachings, the sad consequence of iniquitous legislation.

The skull of the female gorilla differs from the skull of the male, just as the skull of the woman differs from the skull of the man. And this difference has not been caused by centuries of oppression; it merely gives evidence of the healthy operation of that natural law by which structure corresponds more or less to function. In some respects the skull of the female gorilla is more human in its form than that of the male; and so, also, in some respects the skull of the woman exhibits, in a more striking manner, the attributes of humanity than that of the man. Nor are these skull differences restricted to a few species; they extend throughout almost the whole of the vertebrate family; they are accompanied by differences of muscular development, which are no less constant; and the whole of these physical differences are correlated with a psychical difference which is indisputable—the greater pugnacity of the male as compared with the female. Considered, then, apart from individual peculiarities, the diversities of male and female capacities may be seen to have arisen from the widespread action of natural laws, and are not to be annihilated by a merely human decree. It is not the fault of the male human being that he possesses more, than the female, of that combativeness which is necessary, not only in political life, but even in the ordinary struggles for existence. It is his privilege to protect, and hers to be protected.

It may be suspected that the advocates of a sexual revolution have been unfortunate in their experience of the sex opposed to their own. There is no doubt that, century after century, women have shown a preference for men possessing the qualities which seemed to them distinctively masculine; and that men have wished their wives to possess the virtues which are considered distinctively feminine. In other

words, the intellect of either sex has found pleasure in association with something dissimilar to itself, not because one is better or worse than the other, but simply because the two are different. There is no more reason for the assertion that a woman's brain is an undeveloped man's which requires cultivation, than for the assertion that a man's pelvis is an undeveloped woman's which requires to be expanded, or that some of his muscles should be converted into fat. To him it is not, as a rule, given to express himself so rapidly as a woman; to her it is not, as a rule, given to think so deeply as a man. But she often sees what is lost to him during a fit of abstraction; and he is often indebted to her for the materials upon which his reflection may work. Genius, it has often been said, is of both sexes at once; and the saying well indicates the true relation of the male and female intellects. Each has powers and beauties of its own; each may profit by contact with the other, and it is not until some resemblance to a combination of the two has been effected that men recognize that highest mental development to which they give the name of genius.

There are few subjects interesting to man in which clever women do not sometimes also take an interest; and from this fact it has been hastily inferred that women might, with profit, devote the same attention as men to any and every branch of study. Such an inference leaves out of sight the fact that women rarely look at any subject from the same point of view as men; their opinions often have the value which is to be found in the observations of an intelligent spectator when persons, whose whole attention is absorbed in any pursuit, fail to perceive what most concerns them. The best critic is not always a good author or composer; and excellent suggestions are frequently made by those who are not fitted by Nature to carry their own ideas into operation. This is especially the case with women, who, if they were to devote their whole energies to science or to politics, would do violence to their physical organization. The prolonged effort which is necessary in order to work out any great scheme, to make any great discovery, to colligate any vast mass of materials by a great generalization, is a heavier strain on the vital powers than any merely physical exertion. It is, like military service, inconsistent with that bodily constitution which is adapted to maternity, and all that maternity implies; nor does it seem possible that by any process of selection, either natural or human, this difficulty can be overcome. The change in woman's nature must (if effected at all) be effected either in one generation or more; if in one, humanity must immediately cease to exist; if in more, humanity would only be extinguished by degrees; but the diversion of woman's vital powers, from the course which they take by nature, is neither more nor less than the abolition of motherhood. And this, either wholly or in part, either directly or indirectly, is what some earnest men are preaching in the name of sexual equality.

The modern attempts to deprive woman of her womanliness belong

to the metaphysical school of thought, as much as any dogma of a mediæval schoolman. They start from the assumption that living women either conform, or should be forced to conform, to some *a priori* definition of woman, evolved from the inner consciousness of a human being. They ignore all the ascertained facts of anatomy and physiology. They are directed not toward the perfection of womanhood in all its functions, but toward the transformation of woman into something different. They suggest not the study of natural laws, nor the observation of facts in Nature, but the worthlessness of all facts, and all laws, in comparison with a *dictum* issued from the study. It is not wonderful that ignorant enthusiasts should have placed woman in a false position through their inability to comprehend their own religion, but it is perhaps the strangest feature of the nineteenth century that thousands of persons advocate a still more unnatural revolution of the sexes in blind obedience to a purely metaphysical proposition.

The stages into which Auguste Comte divided the progress of human thought are admirably illustrated by modern attempts to alter the position of woman. Seventeen hundred years ago she was a stumbling-block in the way of the religious enthusiasts; to the metaphysicians of to-day she is no more than an abstraction. The early fathers of the Christian Church regarded her physically as a temptation to sin; some modern philanthropists regard her intellectually as the equal of man. It is possible that there may be truth in both opinions, but it is certain that the whole truth is not to be found in either. The religious doctrine is intelligible enough at first sight, but the metaphysical doctrine takes us back to the middle ages, to the conflict between the realists and the nominalists, to the verbal quibbling in which great minds, for want of better occupation, frequently expended all their energies. The woman for whom a vote is demanded is not, when carefully inspected, a woman of flesh and blood, but an abstract or archetypal idea for which the realists of the nineteenth century claim a positive existence.

The process by which such ideas were arrived at in former times, and by which, in all probability, they are arrived at now, is of the following character: Men and women possess certain attributes, or a certain attribute, in common, and to this attribute, or to these attributes collectively, may be given the name of humanity. All points of difference are by the very nature of the process disregarded, or drawn off, or in technical language *abstracted;* or rather the point of resemblance is *abstracted* from the point of difference. Now, when humanity and similar abstract terms had been thus invented by men who perceived their value as a species of mental short-hand, they were invested with a substantial existence by Plato and many of his mediæval followers. The "humanity" which is reached by this mental operation is, of course, divested of sex along with all other differences. If the

human beings who are actually born into the world could in reality, or even in imagination, be made to conform to this sexless archetype, there could be no objection to voters on the score of sex. Thus much may be safely admitted; but it would then be in the power of any human being to coin such a word as "mammality," or "animality," or to make use of the old word "entity," to assert the existence of a substance corresponding to each word, and so to destroy not only the distinction between man and brute, but between organic and inorganic matter. In short, the very same argument which would introduce woman to man's occupations on the ground of her humanity, would introduce whales on the ground of their mammality, or stocks and stones on the ground of their entity.

I trust that I shall not be considered guilty of any disrespect in reducing some well-known arguments of some justly influential thinkers *ad absurdum*. I no more mean to show disrespect by my treatment of the subject, than to deny the sincere philanthropy of many who advocate woman's rights, when I say that it savors not a little of priestcraft. Just as the metaphysical stage of thought bears a great resemblance to the religious, so the attempt to carry a philosophical doctrine into execution is by no means unlike the attempt to impose a creed. Every ideal form of government which has hitherto been conceived has had innumerable elements in common with the Church of the middle ages. From the time of Plato to our own, philosophers have always presented themselves upon the domestic hearth to dictate the relations between husband and wife; all who are acquainted with the early books of penance will remember that the priest took upon himself the same office, even to the minutest details. In all the mediæval works which touch upon science it will be found that the final authority upon every controverted point is not the evidence which may be discovered, but the doctrine of the Church; so neither Plato nor Malthus, nor the followers of either, appeal fairly to physiological facts or laws, but would repress the very instincts of human nature wherever they are opposed to the philosophical idea.

The apostles of all religious and all metaphysical doctrines have commonly been not only energetic but thoroughly honest men. They would direct all thought and all action into the groove worn by their own minds, not from an innate love of tyranny, but from an enthusiasm which cannot admit the possibility that persons of a different opinion may be in the right. In the apostle there is always much to admire, but it happens only too often that his priestly successor inherits his faults without his virtues. The present may be called the apostolic age of the doctrine of equal humanity; and many followers will be won through respect for the character of the apostles, rather than from conviction after sober consideration. But, to the student who desires something positive in science, and who would use that science for the benefit of mankind, there is sad discouragement in the spectacle of a

new intellectual crusade for an idea. To this there are only two possible issues—on the one hand, complete failure; on the other hand, government by a metaphysical priesthood which will not even spare sex in its efforts to crush out all individual preëminence.

It may, perhaps, be thought that the Anthropologist who endeavors to assign woman her true position according to the laws of Nature is practically not less tyrannical toward her than the reformer who would have her modelled according to rules of his own. There are, however, two most important distinctions to be borne in mind: In the first place, the man of science knows from observation and experience that when structure is healthily developed, and function of every kind unimpeded, there results the nearest approach to happiness of which any individual is capable. But the Utopian of the *a priori* school gives no pledge for happiness except a general proposition, or a series of general propositions, well enough suited to the days of Plato, but wholly without value in the days of Darwin. In the second place, the propounders of new schemes make no provision for exceptional cases, but would reduce all mankind to one dead level, while variation is admitted, and the efforts of remarkable individuals are watched with interest by the observers of Nature. The latter, conscious that they are not yet masters of the universe, would allow fair play to all alike, in the hope of learning something new; the former, tacitly assuming that the apex of knowledge is reached, would issue edicts, from their metaphysical Olympus, for the reconstruction of humanity.

There cannot be a doubt that human beings exist who, though not of the male sex, have more masculine intellects than many men, and others whose muscular development and power of enduring fatigue are far superior to those of many a conscript. Had conquerors possessed Utopian minds, they would long ago have declared the fitness of women for military service, for which they are adapted just as well as for political life. But it is only in such a work as the "Republic of Plato" that we find a plea for the application of the same physical training to both sexes. In that treatise[1] an objector is made to suggest that the spectators would begin to laugh if men and women were seen struggling together in the same arena. The philosopher, whose ideal republic would have possessed an hermaphroditic army, could not see the point of the joke, and expressed a profound contempt for the sneers of the unphilosophic. It is, however, worthy of remark that, although he would gladly have seen women converted into wrestlers, boxers, and soldiers, and even thought of giving them a share in the government of the state, he declared them to be in all things weaker than man. The idea of absolute equality is of quite modern growth, and has probably been suggested by the undeniable success of the female intellect in many fields of literature.

To write ingenious novels, and even successful dramas, to paint

[1] Book v., cc. iii. to vi.; see, also, the "Laws," book vi., c. xxiii.

from Nature, to interpret the works of the greatest musical composers, to act with taste and discrimination—all these, and a thousand similar accomplishments, each requiring an effort of intellect, are now within the range of women who are no more exceptional than the front rank of men in every generation. Such distinctions may be attained by women who lose none of the charms of womanhood; and even a knowledge of the latest discoveries in science is in no way incompatible with any of the feminine graces. But a little consideration will lead to the conclusion that all this mental activity is but the evidence of human progress in general, and that its root, as well as its most perfect development, is to be found in the domestic life. Long before the invention of printing, mothers amused their children with nursery-tales, lulled them to sleep with songs, and imparted to them the rudiments of such knowledge as the world possessed; maidens and wives could act well enough to deceive husbands or attract lovers in the days of Homer or even of the patriarchs. And many of those beautiful poetical stories which constitute the mythology of all imperfectly civilized nations bear the stamp of woman's imagination, and have often been narrated to excite or to soothe the terrors of the young.

Women, however, with intellects truly masculine, are, and have always been, even more rare than women with a masculine development of muscles. There are few, if any, distinctively masculine pursuits in which any women have ever succeeded; there is no great law of Nature, no great mechanical invention, no great legal code, nor even any great metaphysical system, of which any woman can say, "Of this the world owes the knowledge to me." A reason for this fact is to be discovered not in the inferior quality of the feminine mind, but in the character of the objects to which woman's physical organization naturally directs her attention. The practice of medicine, which is now becoming recognized as a feminine occupation in America, suggests at once that instinct for nursing, which every one admits to be the special gift of woman, and which is, in fact, a correlate of her power to become a mother. In short, if there be any truth in science, the intellect of woman not only has, but must have, a certain relation to her structure; and, if it could be shown that there exists no difference between the male and female minds, there would be an end of anthropology. But the directions in which clever women have developed their mental activity afford the best possible illustrations of the scientific view of woman's position, and show how the long-inherited instinct matures itself according to the truly feminine type. All the different lines, when traced back, converge through the nurse upon the mother.

It should not, however, be forgotten that there may be individual peculiarities of structure, caused by circumstances either antecedent or subsequent to birth, that the constitution of society may

impede the natural development of function, and that there may be a number of women in every age whose case demands special consideration. Though the births of males are slightly in excess of the births of females, the females in the prime of life exceed the males in number, and it follows, therefore, that, even could every male afford to marry, there would still be some women husbandless. The difficulty which here meets us is only one among many of those which appear irremediable not only to statesmen, but to men of science; it is no more probable that the body social will ever be so constituted as to secure the happiness of every individual, than that the human frame will cease to be subject to disease. There is, indeed, no doubt that the science of health and the science of politics are closely allied, and that each must be imperfect without the other. The end of both is the extinction of mental and bodily pain, but that end seems to be unattainable. Anatomists and physiologists know only too well that, had freedom from disorder been the object with which our organs are constructed, the means would have been lamentably ill adapted to the end, that every malady is easily induced, and with difficulty checked, and that the greater part of mankind start in the career of life with some inherited weakness. It is true that much has been done toward the mitigation of epidemic diseases, and it is possible that something may be done toward the alleviation of social grievances; but the success which has been achieved in one case affords a very instructive lesson toward the mode of proceeding in the other. Epidemics have been deprived of their worst sting, not by any political theories, nor by a statement of human rights, nor by a definition of man or woman, nor by a refusal to consider our physical organization, nor by any attempt to alter it, but by a careful study of the facts of Nature, and by placing humanity, such as it is, in a more favorable condition toward the outer world, such as it is.

How the woman who cannot marry may be most favorably placed is a problem which can hardly be solved in general terms, and which must be answered according to the exigencies of each particular case. But it may be safely asserted that the gift of votes to the whole female sex would not in any way improve the condition of old maids; wherever keenness of observation and a retentive memory are of service, there is a good prospect of success for a cultivated female intellect. In proportion as the instincts of sex are suppressed, the range of acquisition may be widened. Woman naturally loves to teach the young, and, when she is without husband, home, or children, she may well succeed in teaching more than children can learn. She naturally loves to tend the sick of her family, and, when she is without family ties, she may, perhaps with advantage, add a knowledge of medicine to her other gifts, and bring comfort to the bedside of strangers. In short, she may exercise her feminine capacities in a more extended field of action than that of her own house; but, should she ever enter fairly

into competition with men in all professions, she will have ceased to be woman, though she will not have become man. The experiment, could it really be made on a small scale, would not be without its interest to the students of science, though, from the conditions of the problem, it could never be made to illustrate any theory of the origin of species. To the unwomanly woman it is a virtue to be childless.

A state with an hermaphroditic form of government, if even it could exist for a generation, is by Nature doomed to extinction; it may, however, be worth while to consider what kind of being a woman would become who should take an active part in the election of a representative. As an energetic member of his committee she would have to fight the battle, foot by foot, with his opponents of either sex; she could not always sit at home and restrict herself to the use of a voting-paper, because she would then tacitly admit her unfitness for political life with all its hard work and its turmoil of speech-making; she would be like a foreigner giving a vote from a distance, without a knowledge of the qualities requisite for success in Parliament. It would be necessary for her to be thoroughly prepared for the fray—breeched instead of petticoated, with a voice hoarse from shouting, with her hair cropped close to her head, with her deltoid muscles developed at the expense of her bust, prepared with syllogisms instead of smiles, and more ready to plant a blow than to shed a tear. She hurries from her husbandless, childless hearth to make a speech on the hustings; with hard biceps and harder elbows she forces her way through the election mob; her powerful intellect fully appreciates all the ribald jests and obscene gestures of the British "rough;" she knows the art of conciliating rude natures, and can exchange "chaff" with a foul-mouthed costermonger; or, if necessary, she can defend herself, and blacken the eye of a drunken bargee. She has learned all the catechism of politics, and when she mounts the platform she can glibly recite her duty to the world according to the side she has chosen. Experience has taught her the value of invectives, and she denounces her opponents with a choice selection of the strongest epithets; at first she speaks loud in a tone of contentment and self-satisfaction; she ends by losing her temper and bawling at the top of her voice. The crowd, never very indulgent, has no mind to respect a sex which makes no claim and has forfeited all right to forbearance. The hardened lines of her face are battered with apples, brick-bats, and rotten eggs—the recognized weapons of political warfare. Perhaps the very place where she stands is the mark of a storming-party; and, after enjoying the glory of an encounter with a prize-fighter (it may be of her own sex), she is at last brought to the ground by superior skill and strength. Then probably she retires to her home; but I, for one, had rather not follow her thither, or into that House of Parliament of which she is destined one day to become an ornament.

Such a description, I am aware, could only be applied to an election-

eering woman in modern Britain, and not to an inhabitant of Utopia. In that, or some other republic of the future, not only is woman to be different, but man also; the sexes are to lose their characteristic distinctions not simply by the conversion of woman into man, but by the partial conversion of man into woman. As soon as this sexual compromise has been effected, by means not clearly described, the world will enjoy what enthusiastic heathens used to call the golden age, and what modern enthusiasts of another school now call the millennium. Envy, hatred, malice, and all uncharitableness, will disappear, there will be neither wars nor rumors of wars, and an angelic population will know its own place and limit itself to its own number. Mankind will then have developed itself into a species of gigantic trade-union, in which women and their accomplices will infallibly be "rattened" if they create too much competition among men.

A state of society in which humanity shall no longer be human, in which not only sex, but intellect and emotion, shall have been remodelled, and the aspect of the outer world changed by a new and metaphysical cosmogony, is, like the doctrine of abstract right, beyond the grasp of the humble Anthropologist. His occupation will be gone as soon as that era shall commence. But, until then, until murder, theft, and villany of every kind, shall have been extinguished, until that struggle for existence, which pervades all Nature and constitutes the only healthy check upon population, shall have been abolished, until every evil passion shall have been rooted out, he may perhaps be permitted to raise his feeble protest against innovations which would not only subvert man's civilized customs but contradict Nature's first lessons. If statesmanship can amend the laws which press hard upon some unfortunate and exceptional women, if ingenuity can devise harmless occupations for mothers whom prosperity or adversity has deprived of their maternal cares, in short, if any grievance can be met with a remedy which is not opposed to the teachings of science, every human being will have cause for gratitude. If men have met with women who prefer political to domestic life, and despise all conceptions but those which are purely mental, let them in the name of liberty cultivate their acquaintances; but let them also, in the name of liberty and in the name of Nature, permit other men and other women to choose for themselves. If they have but little liking for women who are womanly, if they care nothing for the conversation and the tone of thought which are most in accordance with woman's voice, and mouth, and brain, if they are unable to realize that pleasure which either sex may derive from the sense of intellectual difference, let them by all means endeavor to gratify themselves, according to their own constitution, but let them not, Vandal-like, attempt to destroy those beauties which they do not appreciate.—*Anthropological Review*

THE EARLY SUPERSTITIONS OF MEDICINE.

By W. B. CHEADLE, M.D.

IN the earlier ages of mankind, when the knowledge of Nature was small, and confined to priests and sages, their explanations were received with a simple childlike faith by the people, who cared not, or, if they cared, dared not to question or inquire further. These explanations were, for the most part, mere fanciful and arbitrary guesses, founded, not upon ascertained facts, but on the simplest conceptions arising from the consciousness of some supreme power or powers, which governed the universe, and accommodated to the religious theories of the time. All the mysteries of Nature were solved by the supposition of innumerable supernatural agents, according to whose caprice mankind were injured or benefited, punished or rewarded. Medicine was consequently intimately associated with religion; among the more barbarous nations, the priest and the medicine-man were identical; and, among the more civilized, the recognized practice of it was confined to the sacerdotal orders until the thirteenth or fourteenth century. Neither the priests nor the people of the superstitious age could understand invariable laws.

If a solar eclipse took place, a dragon was supposed to have swallowed up the sun; if an earthquake occurred, or a volcano burst forth, some subterraneous demon was presumed to be at work. When a pestilence raged, the invisible arrows of an offended deity struck down the victims. A man who lost speech or hearing had a dumb devil or a deaf one. We see the same condition of mind exemplified now in the fetichism of barbarous nations, and the belief in charms and sorcery which still obtains among the vulgar, even in this country. But at no period was it more conspicuous than in the middle ages, when the belief in magic and witchcraft gave rise to the terrible atrocities which were perpetrated in the punishment of those who were supposed to plot evil against their fellows by direct compact with and assistance from the devil. If a man suffered from pain in the region of the heart, or in the head, a witch inflicted these tortures by secretly sticking pins into the corresponding portion of a wax image representing the sufferer, and thousands of unfortunates were burnt for causing disease and death by their unholy incantations. The dancing mania, which arose in Flanders and Germany during the fourteenth century, was regarded as a display of satanic power, and the popular reason assigned was that the boots with pointed toes, which had been lately introduced, were peculiarly offensive to the Almighty!

With the belief in witchcraft and sorcery, prevailed also the belief in astrology, and that so universally, even among the more highly-educated, that, although occasionally some daring minds raised their

voices against the delusion, the storm of obloquy and contempt which was showered on them served to show the strength and popularity of the superstition. The heavens were divided, by the most educated men of the time, into houses of life and of death, of riches, marriage, or religion, and the particular planet which chanced to be in any one house at the time, was denominated the lord of the house, in power over the destinies of mankind, unless a greater than he reigned elsewhere.

While this firm belief in magic, and this disposition to refer all diseases to the direct interposition of supernatural agencies, continued to prevail, the science of medicine necessarily remained almost stationary, or rather could hardly come into existence. Few ever thought of trying to find out *how* sorcerers, demons, and planets did their work—and the Church terribly punished all who dared to attempt the investigation. As magic—a mysterious power which man could not understand, but thoroughly believed in—caused diseases, so a kind of magic was trusted to cure them. The efficacy of relics and charms was universally acknowledged. The efforts of physicians were directed to the invention of nostrums and counter-charms—not to the investigation of the causes of disease, the careful observation of their phenomena, or the mode of action of the remedies prescribed for them. Galen had, indeed, made important discoveries in anatomy in the second century, and Mondino and others had added to them; but their knowledge was rude and imperfect, and their deductions vitiated by the most absurd physiological dogmas. When they had discovered a few broad and simple facts in anatomy, they rested from their labors, well content; and founded theories, supported by unfounded assumptions, but which became articles of faith, received without question by their successors in the study. Galen, for example, assumed that the arteries carried the purest blood from the left ventricle of the heart, to the higher and more refined organs, the brain and lungs; while the veins conveyed that of inferior quality from the right ventricle to the grosser organs, the liver and spleen. He chose, moreover, to affirm that the venous blood was not fit for its office, unless some portion of the essence or spirit, and of the arterial blood contained in the left ventricle, were infused into it. Now, these two chambers of the heart, each containing the different quality of blood above mentioned, are separated by a partition, through which there is no aperture whatever. Holes of communication were, however, required by Galen to support his theory, and, therefore, in the true spirit of the time, holes were accordingly seen by him. He squared his facts to suit his theory. And, stranger still, although the heart was frequently examined afterward, so paramount was the authority of Galen, that these imaginary holes were seen by a succession of anatomists for fourteen hundred years, until, at last, Vesalius dared to declare that he could not find them.

This profound reverence for authority, this belief in supernatural agencies, and this stagnation of true science, was the condition which prevailed at the beginning of the sixteenth century. But education gradually spread, and at this time thinkers arose, who, dissatisfied with mere assumptions, or the baseless dicta of previous authorities, commenced working at the rudiments of the science which had hitherto rested on such imperfect foundations.

Protestantism broke forth, marking the commencement of the age of free inquiry, the spirit of which had so often been quenched in blood to burst forth again irrepressibly, and henceforth to continue and spread abroad with little interruption. The Italians—and more especially the republican Venetians—appear to have been peculiarly free from the prejudice against the dissection of human bodies which generally prevailed; the study of anatomy was warmly encouraged at Padua and Bologna; and, owing to this liberal spirit, Mondino, in the fourteenth century, was enabled to demonstrate human anatomy by actual dissection. But he was so trammelled by tradition and the authority of Galen, that he perpetuated numberless errors, which would have been patent enough to an unprejudiced mind. So powerful were these influences, even two hundred years later, that Berenger, who boasted of having dissected one hundred subjects at Bologna, and who added largely to anatomical knowledge, ventured to dispute or correct but few of the propositions of his predecessors in the study. To Vesalius belongs the credit of daring to expose the errors of the Galenian system. A Fleming by birth, he early migrated to Venetia, and lectured with immense success at Padua, and afterward at Bologna and Pisa. So prominently does his simple adherence to facts and disregard of tradition and prejudice, exhibit him as superior to the more servile workers in the science of medicine before his time, who were in reality mere commentators on Hippocrates and Galen, that he has been called the father of human anatomy. He elaborated a comprehensive system, which, although necessarily incomplete, contained few mistakes, and he exposed and corrected a vast number of errors, which, up to that time, had been received without question.

The beginning of the sixteenth century, when Luther nailed his ninety-five propositions to the gates of Wittenberg, marked the commencement of a new era in science, as well as in religion. The spirit of Protestantism influenced the study of medicine, and Vesalius did not stand alone. Linacre, who had studied at Padua before the time of Vesalius, had just established the College of Physicians in London, thus emancipating medicine to a great extent from priestly influence. Hitherto the power of approving and licensing practitioners had been committed to the bishops in their several dioceses, and the practice of physic was accordingly engrossed by illiterate monks and other ignorant empirics, who, as the charter of the

college expresses it, "boldly and accustomably took upon them great cures, to the high displeasure of God, the great infamy of the faculty, and the grievous hurt of his Majesty's liege people." Physicians had gradually become distinct from the sacerdotal order on the Continent, and as early as the beginning of the fourteenth century we find that monks were expelled from the hospitals by the University of Vienna for their "insatiate avidity, and flagrant incompetency," and the care of the sick poor given into the hands of the laity. The monks revenged themselves by procuring an order from the Pope, prohibiting physicians from visiting their patients a second time, without summoning a priest to attend also!

From the Protestant era, original investigation and the accumulation of facts from accurate observation proceeded with a rapidity and certainty beyond all previous experience. Their progress was, nevertheless, impeded, and the value of the results produced depreciated by several opposing influences.

The Romish Church, ever intolerant of novelties which did not emanate from herself, viewed with apprehension and hatred all scientific discoveries, since they were subversive of dogmas which infallibility had sanctioned and approved. Roger Bacon was persecuted by a priesthood said to be so ignorant that they knew no property of the circle, except that of keeping out the devil—and the cry of sorcery or heresy was raised against succeeding explorers of Nature to the time of Galileo. It is terrible to think how many great lights must have been extinguished, how many great discoveries nipped in the bud, by the rigorous stamping out of heresy and unholy pursuits, carried on by the Inquisition. And Protestantism, which had its origin in a similar spirit of inquiry, deprecated with almost equal bigotry, though with less power, every conclusion which seemed contrary to her own interpretation of the word of God. God had afflicted Job with horrible diseases, and the history of the demoniacs proved that devils could derange bodily functions; therefore to doubt these causes was to impugn the veracity of the Bible.

As late as the year 1699, the Royal Society was attacked by theologians soon after its foundation, on the ground that the society neglected the wiser and more discerning ancient philosophers, and depended too much on their own unassisted powers—that, by admitting men of all religions and all countries, they endangered the stability of the Established Church—and, more than all, that a philosophy, founded on experiment, was likely to lead to the overthrow of the Christian religion, and even to a formal denial of the existence of God. And about this time, the orthodox and devout Willis, who gave all his Sunday fees in charity, who procured a special early service daily at a church in St. Martin's Lane, in order that he might be able to attend before he visited his patients, and dedicated his treatise, "De Animâ Brutorum," to the Archbishop of Canterbury, was condemned by the

theologians of the day as tainted with heresy, because he ventured on some speculations not sanctioned by the verdict of antiquity.

The Humoral Pathology had been established as a simple explanation of ordinary diseases, which the more educated people had begun to think might be owing to natural causes; but the pestilences which ravaged nations, and indeed any strange and unaccountable malady, were still unhesitatingly referred to some unpropitious conjunction of the planets, or the machinations of the devil. This Humoral Pathology assumed the existence of four humors in the body, viz., blood, melancholy, choler, and phlegm. Blood was supposed to be formed by the liver, melancholy by the spleen, choler by the gall-bladder, and phlegm by the stomach. The temperament of each individual was termed sanguine, melancholy, choleric, or phlegmatic, according to the humor naturally predominant in his constitution, and one fluid prevailing with abnormal excess over the others gave rise to morbid conditions. The faculty still held to the doctrine of "signatures," as it was called, as the basis of therapeutics; which doctrine assumed certain remedies to be potent in certain diseases, because there was some external resemblance or fanciful connection between the two. Thus, scarlet bed-curtains were a cure for scarlet fever, measles, or any disease with a red eruption on the skin, and the grandfather of Maria Theresa died of small-pox, wrapped, by order of his physicians, in twenty yards of scarlet broadcloth! The yellow powder turmeric was a remedy for jaundice, the lung of the long-winded fox a cure for asthma and shortness of breath; the heart of a nightingale was prescribed for loss of memory; the royal touch was a specific for scrofula or king's evil; and we find John Brown, chirurgeon-in-ordinary to Charles II., writing a treatise on the "Royal Gift of Healing Strumæs by Imposition of Hands," with a description of the proper and efficacious manner of conducting the ceremony. This delusion actually held its ground until the eighteenth century, when the great Dr. Johnson was touched by Queen Anne.

As late as 1623, Sir Kenelm Digby, the Admirable Crichton of his time, produced a sympathetic powder which was to cure wounds even when the patient was out of sight. This powder had extraordinary success, and its efficacy was almost universally acknowledged.

The more advanced minds were, in truth, not yet in the condition most favorable to the development of the sciences. Men of the most daring and original minds were tainted with superstition and credulity. Luther believed that the devil tormented him with earache; he emphatically enforced the duty of burning witches, and earnestly recommended some anxious parents to destroy their son, whom he declared to be possessed by an evil spirit! The belief in witchcraft was still universal, and the last witch was not burnt until 1722. Bishops, judges, magistrates, and learned men, all agreed in crediting the reality of sorcery and the efficacy of astrology.

Men wasted their time and energies in discussing whether a spirit could live in a vacuum, and whether, in that case, the vacuum would be complete; and whether Adam and Eve, not being born in the natural manner, possessed the umbilical mark. They theorized concerning the nature or essence of vital principles and other mysterious entities, and heaped hypothesis on hypothesis, careless of their foundations. Van Helmont, who is immortalized by the discovery of the gases, adopted as an established fact a theory which he founded on the hypothetical "archæus" or entity of Paracelsus. The archæus being an immaterial force or spiritual agent, Van Helmont believed that each member of the body had its own particular archæus, subordinate to the central or principal archæus, which he localized in the stomach; and, as he found that nauseating medicines impaired mental vigor, he assigned to the stomach the seat of the intellect also. Thus, although he made great discoveries in chemistry, his physiology was wildly imaginary and unwarrantably assumptive, and detracts from the fame which his valuable researches in chemistry conferred upon him.

The matter-of-fact Vesalius, too, who had dared to fail in seeing the openings through the septum of the heart, which Galen had declared to exist, did not dream of disputing the theory of that authority concerning the distribution of the blood, which required that the blood from the two ventricles should intermingle, and therefore imagined that it distilled through the pores of the unbroken and impermeable partition; and, contrary to what seems to have been his general temper, he steadily denied the existence of valves in the veins, which had been observed by others, although he might have verified their statements had he been in this instance open to conviction. Servetus, also, the victim of Calvin, who burnt him and his works together at Geneva, when he had discovered the pulmonary circulation, and almost grasped the great secret afterward found out by Harvey—the complete circulation of the blood—instead of proceeding with the investigation, assumed all other errors except the one he had disproved, and describes how the air passes from the nose into the ventricles of the brain, and speculates how the devil takes the same route to the soul. The spirit of the age continued eminently unpractical, and men took interest in facts only as they could be bent to the support of preconceived theories, "spinning," as Lord Bacon says, "like the spider, the thread of speculative doctrine from within themselves," and regarding the perfection and symmetry of their production, rather than its truth and certainty.—*Abstract from Fortnightly Review.*

PREHISTORIC TIMES.[1]

By Dr. T. M. COAN.

Ethnology is passing at present through a phase from which older sciences have safely emerged. The new views with reference to the antiquity of man are still looked upon by some persons with distrust and apprehension. Yet, says the distinguished author, of whose researches we are about to give some account, these new views "will, I doubt not, in a few years, be regarded with as little disquietude as are now those discoveries in astronomy and geology which at one time excited even greater opposition." It is now pretty generally admitted that the first appearance of Man in Europe dates from a period so remote, that neither history, nor even tradition, can throw any light on his origin, or mode of life. Under these circumstances, some have supposed that the past is hidden from the present by a veil, which time will probably thicken, but never can remove. Thus our prehistoric antiquities have been valued as monuments of ancient skill and perseverance, not regarded as pages of ancient history; recognized as interesting vignettes, not as historical pictures. Some writers have assured us that, in the words of Palgrave, "we must give it up, that speechless past; whether fact or chronology, doctrine or mythology; whether in Europe, Asia, Africa, or America; at Thebes or Palenque, on Lycian shore or Salisbury Plain: lost is lost; gone is gone forever."

Of late years, however, a new Science has been born among us which deals with times and events far more ancient than any which have yet fallen within the province of the archæologist. The geologist reckons not by days or by years; the whole six thousand years, which were until lately looked on as the sum of the world's existence, are to him but one unit of measurement in the long succession of past ages.

Our knowledge of geology is, of course, very incomplete; on some questions we shall, no doubt, see reason to change our opinion, but, on the whole, the conclusions to which it points are as definite as those of zoology, chemistry, or any of the kindred sciences. Nor does there appear to be any reason why those methods of examination which have proved so successful in geology, should not also be used to throw light on the history of man in prehistoric times. Archæology forms, in fact, the link between geology and history. But, while other animals leave only teeth and bones behind them, the men of the earliest ages are to be studied principally by their works; they have left

[1] "Prehistoric Times as illustrated by Ancient Remains, and the Manners and Customs of Modern Savages By Sir John Lubbock, Bart., M. P., Vice-President of the Royal Society," etc., etc. 8vo, pp. 640. New York: D. Appleton & Co.

behind them houses, tombs, fortifications, temples, implements for use, and ornaments for decoration.

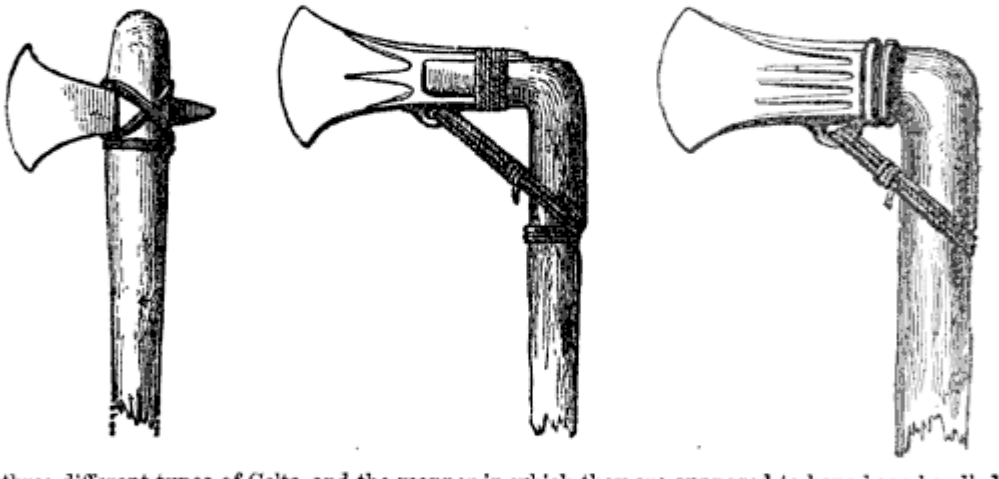
From the careful study of these remains, it would appear that prehistoric archæology may be divided into four great epochs:

1. That of the Drift; where man shared the possession of Europe with the Mammoth, the Cave bear, the woolly-haired rhinoceros, and other extinct animals. This we may call the "Palæolithic" period.

2. The later or polished Stone Age; a period characterized by beautiful weapons and instruments made of flint and other kinds of stone; in which, however, we find no trace of the knowledge of any metal, excepting gold, which seems to have been sometimes used for ornaments. This we may call the "Neolithic" period.

3. The Bronze Age, in which bronze was used for arms and cutting instruments of all kinds.

4. The Iron Age, in which that metal had superseded bronze for arms, axes, knives, etc.; bronze, however, still being in common use for ornaments, and frequently also for the *handles* of swords and other arms, though never for the blades.



The three different types of Celts, and the manner in which they are supposed to have been handled.

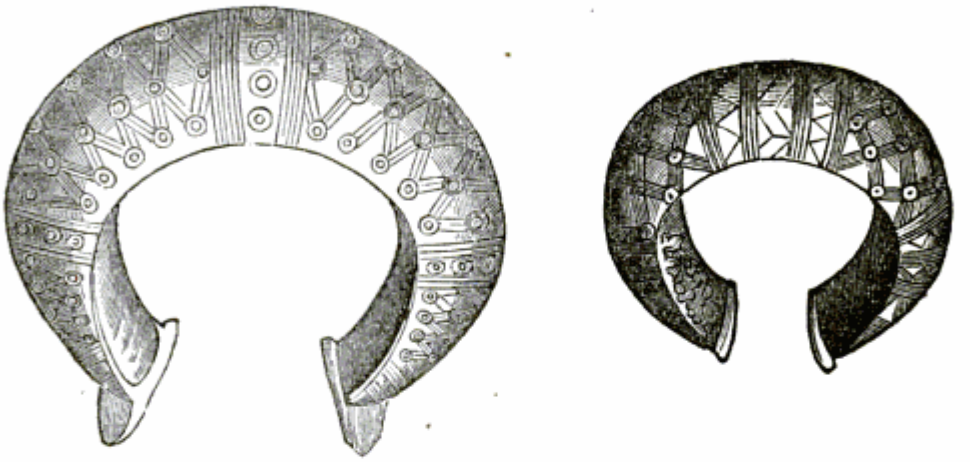
Without attempting a laborious classification of the records of these epochs, we will speak first of some of the records of the "Bronze Age." The commonest and, perhaps, the most characteristic objects belonging to this age are the so-called "celts," which were probably used for chisels, hoes, war-axes, and a variety of other purposes.

Bronze celts are generally plain, but sometimes ornamented with ridges, dots, or lines, as in the accompanying figures. More than two thousand specimens of them are known to exist in the different Irish collections, of which the great Museum belonging to the Royal Irish Academy at Dublin contained in the year 1860 no less than six hundred and eighty-eight, no two of which were cast in the same mould. They vary in size from an inch to a foot in length. That they were made in the countries where they are found, is proved by the presence of moulds. It is difficult to understand why the celt-makers never cast their axes as we do ours, with a transverse hole, through which the

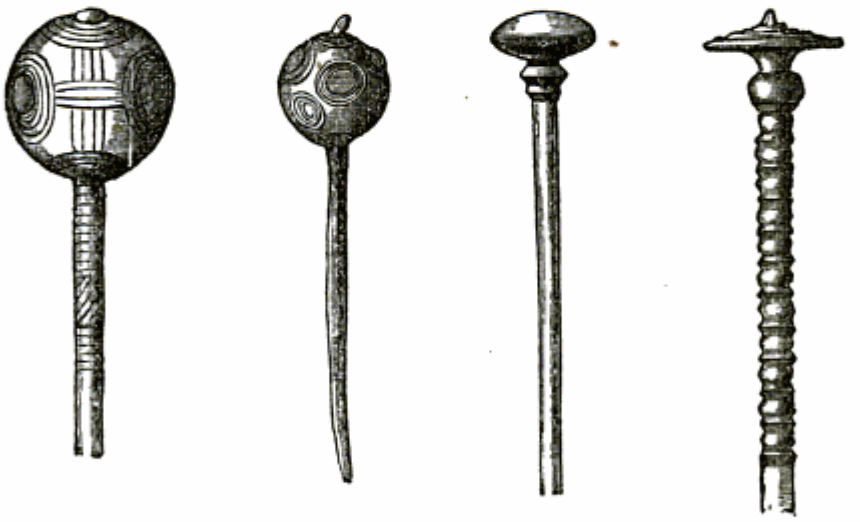
handle might pass. No bronze implements of this description have been yet found in Great Britain, though a few have occurred in Denmark, where they are of great beauty and highly decorated.

The swords of the Bronze Age are always more or less leaf-like in shape, double-edged, sharp-pointed, and intended for stabbing and thrusting, rather than for cutting.

Fish-hooks, knives, bracelets, pins, and rings, of the same era, are also discovered in great numbers in various parts of Europe. They



Bracelets.—Switzerland.



Bronze Hair-pins.—Switzerland.

are well cast, and show considerable skill in metallurgy; and the beauty of their form and ornamentation indicates no little development of the artistic faculties.

We should hardly have hoped to ascertain much of the manner in which the people of the Bronze Age were dressed. Considering how perishable are the materials out of which clothes are formed, it is wonderful that any fragments of them should have remained to the present day; yet, in addition to traces of linen tissue, and of the skins of animals used in this period, we possess the whole dress of a chief belonging to the Bronze Age.

On a farm occupied by M. Dahls, near Ribe in Jutland, are four tumuli, known as Great Kongehoi, Little Kongehoi, Guldhoi, and Treenhoi. This last was examined in 1861. Near its centre were found

Woollen Caps, from Tumulus.

Comb.

three wooden coffins, two of full size, and one evidently intended for a child. The contents of the larger were partially preserved, and very interesting: caps, a comb, two woollen shawls, traces of leather, some black hair, and the brain, remained, when all of the bones had changed into a kind of blue powder. Implements of bronze accompanied these remains, and there seems no doubt that they dated from a prehistoric antiquity.

Many of the dwellings in use during the Bronze Age were no doubt subterranean or semi-subterranean. On almost all large tracts of uncultivated land, ancient villages of this character may still be traced. A pit was dug, and the earth which was thrown out formed a circular wall, the whole being then probably covered over with boughs. The "Penpits," near Gillingham, in Wiltshire, are of this character, and indicate a populous settlement. In Anglesea, similar hut-circles exist. On Dartmoor and elsewhere, where large blocks of stone abounded, the natives saved themselves the trouble of excavating, and simply built up circular walls of stone. In other cases, probably when concealment was an object, the dwellings were entirely subterranean. Such ancient dwellings are in Scotland known as "weems," from "Uamha," a cave. In one of these at Monzie, in Perthshire, a bronze sword was discovered. Such underground chambers, however, appear to have been used in Scotland as dwellings, or at least as places of concealment, down to the time of the Romans; for a weem described by Lord Rosehill was constructed partly of stones showing the diagonal and diamond markings peculiar to Roman workmanship. Sir John Lubbock believes that Stonehenge also belongs to the Bronze Age.

From the independent statements of Homer and in the book of Kings (where the word is mistranslated *brass*) we find that bronze was abundant in the East no less than three thousand years ago. Bronze is composed of about nine parts of copper to one of tin: and copper is found in so many countries that we cannot as yet tell whence the

Phœnicians obtained it. But, unless the ancients had some source of tin with which we are unacquainted, it seems to be well established that the Phœnician tin was mainly derived from Cornwall, and consequently that even at this early period a considerable commerce had been organized, and very distant countries brought into connection with one another. We are justified in concluding that, between B. C. 1500 and B. C. 1200, the Phœnicians were already acquainted with the mineral fields of Spain and of Britain.

Of the still earlier Age of Stone no less than 30,000 relics, mainly in the shape of implements, are preserved in the Danish museums alone. There is enough evidence to justify us in believing that there was a period when society was in so barbarous a state that sticks or stones (to which we must add horns and bones) were the only implements with which men knew how to furnish themselves.

Our knowledge of this ancient period is derived principally from four sources: namely, the tumuli, or ancient burial-mounds; the Lake habitations of Switzerland; shell-mounds of Denmark; and the Bone-caves. There are, indeed, many other remains of great interest, such, for example, as the ancient fortifications, the "castles" and "camps" which crown so many English hill-tops, and the great lines of embankment; there are the so-called Druidical circles and the vestiges of ancient habitations. The majority of these belong, however, in all probability, to a later period; and at any rate, in the present state of our knowledge, we cannot say which, or how many of them, are referable to the Stone Age.

Flint appears to have been the stone most frequently used in Europe, and it has had a much more important influence on our civilization than is generally supposed. Savages value it on account of its hardness and mode of fracture, which is such that, with practice, a good sound block can be chipped into almost any form that may be required.

In many cases block and pebbles of flint, picked up on the surface of the ground, were used in the manufacture of implements; but in other cases much labor was spent to obtain flint of good quality. A good illustration of this is afforded by the so-called Grime's Graves, near Brandon, one of which has recently been explored by Mr. Greenwell. These turned out to be excavations made for the purpose of obtaining flint. The end of an ancient gallery was exposed to view. The flint had been hollowed out in three places, and in front of two of these recesses, pointing toward the half-excavated stone, were two deer-horn picks, lying just as they had been left, still coated with chalk-dust, on which was in one place plainly visible the print of the workman's hand. They had evidently been left at the close of a day's work; during the night the gallery had fallen in, and they had never been recovered.

The flint knives, or "flakes," simple as their forms appear, are

always the work of man. To make one, the flint must be held firmly, and then a considerable force must be applied, either by pressure or by blows, repeated three or four times, but at least three, and given in certain slightly different directions, with a certain definite force; these conditions could scarcely occur by accident, so that, simple as it may seem to the untrained eye, a flint flake is to the antiquary as sure a trace of man as the footprint in the sand was to Robinson Crusoe.

To us, accustomed as we are to the use of metals, it seems difficult to believe that such things were ever made use of; we know, however, that many savages of the present day have no better tools. Yet, with axes such as these, and generally with the assistance of fire, they will cut down large trees, and hollow them out into canoes. The piles used in the Swiss Stone Age Lake habitations were evidently, from the marks of the cuts on them, prepared with the help of stone axes. The great similarity of arrow-heads, even from the most distant localities, may be seen in the accompanying figures, which represent specimens from France, North America, and Tierra del Fuego, respectively.

France.

North America.

Tierra del Fuego.

Of monuments and tumuli belonging to this epoch, there is no lack; throughout the world, they are scattered—camps, dikes, fortifications, cromlechs, or stone circles. In the Orkneys, more than 2,000 of the smaller tumuli still remain. In Denmark, they are still more abundant. They are found all over Europe, from the shores of the Atlantic to the Ural Mountains; in Asia, they are scattered over the great steppes, from the borders of Russia to the Pacific Ocean, and from the plains of Siberia to those of Hindostan; the entire plain of Jelalabad, says Masson, "is literally covered with tumuli and mounds." In America, they are to be numbered by thousands and tens of thousands; nor are

they wanting in Africa, where the Pyramids themselves exhibit the most magnificent development of the same idea; indeed, the whole world is studded with the burial-places of the dead. Tumuli or barrows are much more numerous and more widely distributed than stone circles. No doubt the great majority of them are burial-mounds, but some also were erected as memorials, like the "heap of witness"

Danish Dolmen.

erected by Laban and Jacob, or the mound heaped up by the ten thousand in their celebrated retreat, when they obtained their first view of the sea.

One of the most curious habits of the prehistoric European was that of constructing his dwellings upon piles above the surface of the

Sepulchral Stone Circle.

water. The vestiges of many Swiss buildings of this sort are not unlike those of the Pæonians, described by Herodotus.

"Their dwellings," he says, "are contrived after this manner planks fitted on lofty piles are placed in the middle of the lake, with a narrow entrance from the main-land by a single bridge. These piles, that support the planks, all the citizens anciently placed there at the public charge; but afterward they established a law to the following effect: whenever a man marries, for each wife he sinks three piles, bringing wood from a mountain called Orbelus: but every man has

several wives. They live in the following manner: on the planks every man has a hut, in which he dwells, with a trap-door closely fitted in the planks, and leading down to the lake. They tie the young children with a cord round the foot, fearing lest they should fall into the lake beneath. To their horses and beasts of burden they give fish for fodder; of which there is such an abundance, that, when a man has opened his trap-door, he lets down an empty basket by a cord into the lake, and, after waiting a short time, draws it up full of fish."

And certain savage or semi-savage tribes live in the same manner, even at the present day. The fishermen of Lake Prasias still inhabit wooden cottages built over the water, as in the time of Herodotus. In most of the large Swiss lakes these habitations have been discovered, numbering over 200 at the present date. M. Troyon has endeavored to make a retrospective census of those early times. The settlement at Morges, which is one of the largest in the Lake of Geneva, is 1,200 feet long and 150 broad, giving a surface of 180,000 square feet. Allowing the huts to have been fifteen feet in diameter, and supposing that they occupied half the surface, leaving the rest for gangways, he estimates the number of cabins at 311; and supposing again that, on an average, each was inhabited by four persons, he obtains for the whole a population of 1,244. Sixty-eight villages belonging to the Bronze Age are supposed to have contained 42,500 persons; while for the preceding epoch, by the same process of reasoning, he estimates the population at 31,875.

Abundant animal remains are found in these lake-dwellings, no less, indeed, than 70 species, of which 10 are fishes, four reptiles, 26 birds, and the remainder quadrupeds. The dog, pig, horse, goat, and sheep, are recognized, and at least two varieties of oxen. Remains of the horse are extremely rare. Three varieties of wheat were cultivated by the lake-dwellers, who also possessed two kinds of barley, and two of millet. Of these the most ancient and most important were the small six-rowed barley and small "lake-dwellers'" wheat. The discovery of Egyptian wheat at Wangen and Robenhausen is particularly interesting. Oats were cultivated during the Bronze Age, but are absent from all the Stone Age villages. Rye also was unknown. Altogether 115 species of plants have been determined. It is evident that the nourishment of the dwellers in the pile-works consisted of corn and wild fruits, of fish, and the flesh of wild and domestic animals. Doubtless, also, milk was an important article of their diet.

Much as still remains to be made out, respecting the men of the Stone period, the facts already ascertained, like a few strokes by a clever draughtsman, supply us with the elements of an outline sketch. Carrying our imagination back into the past, we see before us, on the low shores of the Danish Archipelago, a race of small men, with heavy, overhanging brows, round heads, and faces probably much like those

of the present Laplanders. As they must evidently have had some protection from the weather, it is most probable that they lived in tents made of skins. The total absence of metal indicates that they had not yet any weapons except those made of wood, stone, horn, and bone. Their principal food must have consisted of shell-fish, but they were able to catch fish, and often varied their diet by game caught in hunting. It is, perhaps, not uncharitable to conclude that, when their hunters were unusually successful, the whole community gorged itself with food, as is the case with many savage races at the present time. It is evident that marrow was considered a great delicacy, for every single bone which contained any was split open in the manner best adapted to extract the precious morsel. As to the date, however, of this remote savage life, it is as yet impossible to speak with confidence, except to say that it was, in all probability, thousands of years earlier than any historic record.

Our knowledge of North American archæology is derived mainly from the researches of Messrs. Atwater, Squier, Davis, Lapham, and Haven. These remains differ less in kind than in degree from others concerning which history has not been entirely silent. They are more numerous, more concentrated, and in some particulars on a larger scale of labor, than the works which approach them on their several borders, and with whose various characters they are blended. Their great numbers may be the result of frequent changes of residence by a comparatively limited population, in accordance with a superstitious trait of the Indian nature, leading to the abandonment of places where any great calamity has been suffered. The contents of the Indian mounds are very various and interesting. They show that the art of pottery had been brought to a considerable degree of perfection. Various ornamental articles abound in the tumuli, such as beads, shells, necklaces, bracelets, etc. Earthworks for defence are also numerous, especially in the central parts of the States, and the remains of ancient mud-huts have occasionally been found.

The so-called "Sacrificial Mounds" are a class of ancient monuments altogether peculiar to the New World, and highly illustrative of the rites and customs of the ancient races of the mounds. These remarkable mounds have been very carefully explored. Their most noticeable characteristics are, their almost invariable occurrence within enclosures; their regular construction in uniform layers of gravel, earth, and sand, disposed alternately in strata, conformable to the shape of the mound; and their covering, a symmetrical altar of burnt clay or stone, on which are deposited numerous relics, in all instances exhibiting traces, more or less abundant, of their having been exposed to the action of fire. The so-called "altar" is a basin, or table of burnt clay, carefully moulded into a symmetrical form, but varying much both in shape and size. Some are round, some elliptical, and others squares or parallelograms, while in size they vary from 2 feet to

50 feet, by 12 or 15. The usual dimensions, however, are from 5 to 8 feet.

Not the least remarkable of the American antiquities are the *Animal Mounds*, which are principally, though not exclusively, found in Wisconsin. In this district thousands of examples occur of gigantic *basso-rilievos* of men, beasts, birds, and reptiles, all wrought with persevering labor on the surface of the soil, while enclosures and works of defence are almost entirely wanting, the ancient city of Aztalan being, as is supposed, the only example of the former class.

One remarkable group in Dale County, close to the Great Indian War-path, consists of a man with extended arms, seven more or less elongated mounds, one tumulus, and six quadrupeds. The length of the human figure is 125 feet, and it is 140 feet from the extremity of one arm to that of the other. The quadrupeds vary from 90 to 126 feet in length.

"But," says Mr. Lapham, "the most remarkable collection of lizards and turtles yet discovered is on the school section about a mile and a half southeast from the village of Pewaukee. This consists of seven turtles, two lizards, four oblong mounds, and one of the remarkable excavations before alluded to. One of the turtle-mounds, partially obliterated by the road, has a length of 450 feet, being nearly double the usual dimensions. Three of them are remarkable for their curved tails, a feature here first observed."

When, why, or by whom these remarkable works were erected, as yet we know not. The present Indians, though they look upon them with reverence, can throw no light upon their origin. Nor do the contents of the mounds themselves assist us in this inquiry. Several of them have been opened, and, in making the streets of Milwaukee, many of the mounds have been entirely removed; but the only result has been to show that they are not sepulchral, and that, excepting by accident, they contain no implements or ornaments.

Many computations have been made in respect to the actual antiquity of the various prehistoric remains that we have described. Sir Charles Lyell, one of the most cautious of geologists, thinks that 100,000 years is a moderate estimate of the time that has been required to form the alluvial delta of the Mississippi; and he considers that the alluvium of the Somme, containing flint implements and the remains of the mammoth and hyena, is no less ancient.

Many astronomical and climatic proofs are found of the extreme antiquity of the globe; and all geologists, indeed, are now prepared to admit that man has existed on our earth for a much longer period than was until recently supposed to have been the case.

But it may be doubted whether even geologists yet realize the great antiquity of our race. Sir Charles Lyell himself thinks that we may expect to find the remains of man in the pliocene strata, but there he draws the line, and says that in miocene time, "had some other ration-

al being, representing man, then flourished, some signs of his existence could hardly have escaped unnoticed, in the shape of implements of stone or metal, more frequent and more durable than the osseous remains of any of the mammalia."

It is true that few of our existing species, or even genera, have as yet been found in miocene strata; but if man constitutes a separate family of mammalia, as he does in the opinion of the highest authorities, then, according to all paleontological analogies, he must have had representatives in miocene times. We need not, however, expect to find the proofs in Europe; our nearest relatives in the animal kingdom are confined to hot, almost to tropical climates, and it is in such countries that we are most likely to find the earliest traces of the human race.

M. Morlot has made some interesting calculations respecting the age of geological formations in Switzerland. The torrent of the Tinière, at the point where it falls into the Lake of Geneva, near Villeneuve, has gradually built up a cone of gravel and alluvium. In the formation of the railway this cone has been bisected for a length of 1,000 feet, and to a depth, in the central part, of about 32 feet 6 inches above the level of the railway. The section of the cone thus obtained shows a very regular structure, which proves that its formation was gradual. It is composed of the same materials (sand, gravel, and large blocks) as those which are even now brought down by the stream. The amount of detritus does, indeed, differ considerably from year to year, but in the long-run the differences compensate for one another, so that, when considering long periods, and the structure of the whole mass, the influences of the temporary variations, which arise from meteorological causes, altogether disappear, and need not, therefore, be taken into account. M. Morlot's estimates assign about 6,000 years for the formation of the lower layer of vegetable soil, and 10,000 years for that of the whole existing cone. But above this cone is another, which was formed when the lake stood at a higher level than at present, and which M. Morlot refers to the period of the river-drift gravels. This drift-age cone is about twelve times as large as that now forming, and would appear, therefore, on the same data, to indicate an antiquity of more than 100,000 years.

Again, it will be remembered that, side by side with the remains of Arctic animals, have been found others indicating a warm climate, such for instance as the hippopotamus. This fact, which has always hitherto been felt as a difficulty, is at once explained by the suggestion of a change every 10,000 or 11,000 years, from a high to a low temperature, and *vice versa*. But a period of 10,000 years, long as it may appear to us, is very little from a geological point of view. We can thus understand how the remains of the hippopotamus and the bones of the musk-ox come to be found together in England and in France. The very same geological conditions which fitted our valleys for the

one, would, at an interval of 10,000 years, render them suitable for the other. That man existed in Europe during the period of the mammoth, no longer, apparently, admits of a doubt. "When speculations on the long series of events which occurred in the glacial and post-glacial periods are indulged in," says Sir C. Lyell, "the imagination is apt to take alarm at the immensity of the time required to interpret the monuments of these ages, all referable to the era of existing species. In order to abridge the number of centuries which would otherwise be indispensable, a disposition is shown by many to magnify the rate of change in prehistoric times, by investing the causes which have modified the animate and the inanimate world with extraordinary and excessive energy. . . . We of the living generation, when called upon to make grants of thousands of centuries in order to explain the events of what is called the modern period, shrink naturally at first from making what seems so lavish an expenditure of past time."

To the geologist, however, these large figures have no appearance of improbability. All the facts of geology tend to indicate an antiquity of which we are but begining to form a dim idea. Take, for instance, one single formation—our well-known chalk. This consists entirely of shells and fragments of shells deposited at the bottom of an ancient sea, far away from any continent. Such a progress as this must be very slow: probably we should be much above the mark if we were to assume a rate of deposition of ten inches in a century. Now the chalk is more than a thousand feet in thickness, and would have required, therefore, more than 120,000 years for its formation. The fossiliferous beds of Great Britain, as a whole, are more than 70,000 feet in thickness, and many which there measure only a few inches, on the Continent expand into strata of immense depth; while others, of great importance elsewhere, are wholly wanting there, for it is evident that, during all the different periods in which Great Britain has been dry land, strata have been forming (as is, for example, the case now) elsewhere, and not with us. Moreover, we must remember that many of the strata now existing have been formed at the expense of older ones; thus, all the flint-gravels in the southeast of England have been produced by the destruction of chalk. This, again, is a very slow process. It has been estimated that a cliff 500 feet high will be worn away at the rate of an inch in a century. This may seem a low rate, but we must bear in mind that along any line of coast there are comparatively few points which are suffering at one time, and that even on those, when a fall of cliff has taken place, the fragments serve as a protection to the coast, until they have been gradually removed by the waves The Wealden Valley is 22 miles in breadth, and on these data it has been calculated that the denudation of the Weald must have required more than 150,000,000 of years.

EDITOR'S TABLE.

PURPOSE AND PLAN OF OUR ENTERPRISE.

THE POPULAR SCIENCE MONTHLY has been started to help on the work of sound public education, by supplying instructive articles on the leading subjects of scientific inquiry. It will contain papers, original and selected, on a wide range of subjects, from the ablest scientific men of different countries, explaining their views to non-scientific people. A magazine is needed here, which shall be devoted to this purpose, for, although much is done by the general press in scattering light articles and shreds of information, yet many scientific discussions of merit and moment are passed by. It is, therefore, thought best to bring this class of contributions together for the benefit of all who are interested in the advance of ideas and the diffusion of valuable knowledge.

The increasing interest in science, in its facts and principles, its practical applications, and its bearings upon opinion, is undeniable; and, with this augmenting interest, there is growing up a new and enlarged meaning of the term which it is important for us to notice. By science is now meant the most accurate knowledge that can be obtained of the order of the universe by which man is surrounded, and of which he is a part. This order was at first perceived in simple physical things, and the tracing of it out in these gave origin to the physical sciences. In its earlier development, therefore, science pertained to certain branches of knowledge, and to many the term science still implies *physical* science.

But this is an erroneous conception of its real scope. The growth of science involves a widening as well as a progression. The ascertainable order of things proves to be much more extensive than was at first suspected; and the inquiry into it has led to sphere after sphere of new investigation, until science is now regarded as not applying to this or that class of objects, but to the whole of Nature—as being, in fact, a method of the mind, a quality or character of knowledge upon all subjects of which we can think or know.

What some call the progress of science, and others call its encroachments, is undoubtedly the great fact of modern thought, and it implies a more critical method of inquiry applied to subjects not before dealt with in so strict a manner. The effect has been, that many subjects, formerly widely separated from the recognized sciences, have been brought nearer to them, and have passed more or less completely under the influence of the scientific method of investigation. Whatever subjects involve accessible and observable phenomena, one causing another, or in any way related to another, belong properly to science for investigation. Intellect, feeling, human action, language, education, history, morals, religion, law, commerce, and all social relations and activities, answer to this condition; each has its basis of fact, which is the legitimate subject-matter of scientific inquiry. Those, therefore, who consider that observatory-watching, laboratory-work, or the dredging of the sea for specimens to be classified, is all there is to science, make a serious mistake. Science truly means continuous intelligent observation of the characters of men, as well as of the characters of insects. It means the analysis of mind as well as that of chemical substances. It means the scrutiny of evidence, in regard to political theories, as inexorable as that applied to theories of comets. It means the tracing of cause and effect in the sequences of human con-

duct as well as in the sequences of atmospheric change. It means strict inductive inquiry as to how society has come to be what it is, as well as how the rocky systems have come to be what they are. In short, science is not the mystery of a class, but the common interest of rational beings, in whom thinking determines action, and whose highest concern it is that thought shall be brought into the exactest harmony with things—and this is the supreme purpose of education.

If, in this statement of the scope and work of science, we have not laid stress upon those great achievements by which it has given man power over the material world, it is not because we undervalue them. They are noble results, but they are abundantly eulogized, and their very splendor has operated to dim the view of other conquests, less conspicuous, but even more important. Telegraphs, steam-engines, and the thousand devices to which science has led, are great things; but what, after all, is their value compared with the emancipation of the human spirit from the thraldom of ignorance, which the world owes to this agency? Rightly to appreciate what science has accomplished for humanity, we must remember not only that it has raised men to the understanding and enjoyment of the beautiful order of Nature, but that it has put an end to the baneful superstitions by which, for ages, men's lives were darkened, to the sufferings of witchcraft, and the terrors of the untaught imagination which filled the world with malignant agencies.

It is this immense extension of the conception of science, in which all the higher subjects of human interest are now included, that gives it an ever-increasing claim on the attention of the public. Besides its indispensable use in all avocations, and its constant application in the sphere of daily life, it is also profoundly affecting the whole circle of questions, speculative and practical, which have agitated the minds of men for generations. Whoever cares to know whither inquiry is tending, or how opinion is changing, what old ideas are perishing, and what new ones are rising into acceptance — briefly, whoever desires to be intelligent as to contemporary movements in the world of thought — must give attention to the course of scientific inquiry. Believing that there are many such in this country, and that they are certain to become more numerous in future, THE POPULAR SCIENCE MONTHLY has been commenced with the intention of meeting their wants more perfectly than any other periodical they can get.

The work of *creating* science has been organized for centuries. Royal societies and scientific academies are hundreds of years old. Men of science have their journals, in all departments, in which they report to each the results of original work, describe their processes, engage in mutual criticism, and cultivate a special literature in the interests of scientific advancement.

The work of *diffusing* science is, however, as yet, but very imperfectly organized, although it is clearly the next great task of civilization. The signs, however, are promising. Schools of science are springing up in all enlightened countries, and old educational establishments are yielding to the reformatory spirit, modifying and modernizing their systems of study. There is, besides, a growing sympathy, on the part of men of science of the highest character, with the work of popular teaching, and an increasing readiness to coöperate in undertakings that shall promote it. There is, in fact, growing up a valuable literature of popular science —not the trash that caters to public ignorance, wonder, and prejudice, but able and instructive essays and lectures from men who are authorities upon the subjects which they treat. But the task of systematically disseminating these valuable productions is as yet but

imperfectly executed, and we propose to contribute what we can to it in the present publication.

THE POPULAR SCIENCE MONTHLY will make its appeal, not to the illiterate, but to the generally-educated classes. The universities, colleges, academies, and high-schools of this country are numbered by hundreds, and their graduates by hundreds of thousands. Their culture is generally literary, with but a small portion of elementary science; but they are active-minded, and competent to follow connected thought in untechnical English, even if it be sometimes a little close. Our pages will be adapted to the wants of these, and will enable them to carry on the work of self-instruction in science.

The present undertaking is experimental. We propose to give it a fair trial; but it will be for the public to decide whether the publication shall be continued. All who are in sympathy with its aims are invited to do what they can to extend its circulation.

THE WORK OF PROF. MORSE.

PROF. MORSE has completed his career, and taken his place in the past. He belongs now to memory and to fame, and his name and work will help to save our age from oblivion in the distant future. After a few thousand years, when the inferior races of men shall have disappeared from the earth, except perhaps a few samples preserved as antiquarian specimens; when civilization has overspread the world, and the telegraph system has become so universal and perfected that any individual will be able to put himself into instantaneous communication with any other individual upon the globe, then will the name of Morse, one of the great founders of the system, be more eminent than any upon whom we now look back as the illustrious of ancient times.

Prof. Morse illustrated the law of the hereditary descent of talent, being the son of the Rev. Jedediah Morse, the first American geographer. He was born in Massachusetts, in 1791, and graduated at Yale College in 1810. The American inventor of the telegraph, like the inventor of the steamboat, was at first an artist, and distinguished himself both in painting and sculpture. He studied abroad, and received the gold medal from the Adelphi Society of Arts for his first attempt in sculpture. Returning to this country, he was engaged, by the corporation of New York City, to paint the portrait of Lafayette; he assisted in founding the National Academy of Design, was its first president, and gave the first course of lectures ever delivered on art in this country.

In college, young Morse had paid some attention to chemistry and physics, but did not afterward specially pursue them. He took up the subject of electricity much as Franklin did, through the influence of others, and with reference to utilitarian ends. The invention of the Leyden jar, in 1746, set all Europe to experimenting, and the next year Peter Collinson, of London, sent a box of glass tubes, and other things for experimenting, to his friend Franklin, at Philadelphia, who took the electric fever and went enthusiastically to work, giving the world the lightning-rod in five years after he began to investigate. So, while Morse was lecturing on the fine arts, his friend Prof. G. F. Dana was lecturing in the same institution on electro-magnetism, and his attention was thus drawn to the subject. This was in 1826–'27, when much was said of the many and brilliant discoveries in these sciences.

The conception of the telegraph in Prof. Morse's mind dates from 1832, when he was forty-one years old—exactly the age of Franklin when he received his instruments from Collinson, and entered upon the study of electricity. It was in a conversation on electro-magnetism on board the packet-ship

Sully that the idea of instantaneous communication of intelligence by means of an insulated wire occurred to him, "and, before the completion of the voyage, he had not only worked out in his own mind, but had committed to paper, the general plan of the invention with which his name is indissolubly connected. His main object was to effect a communication, by means of the electro-magnet, that would leave a permanent record by signs answering for an alphabet, and which, though carried to any distance, would communicate with any place through which the line might pass. His first idea was to use a strip of paper, saturated with some chemical preparation that would be decomposed when brought in connection with the wire, along which the electric current was passing, and thus by a series of chemical marks, varying in width and number for the different letters of the alphabet, record the message without separating the wire at each point of communication."

Three years were now consumed in experimenting, and in 1835 he had so far perfected his instrument as to be able to show it to his friends, and send by it a message to the distance of half a mile; but, at this time, he could not receive an answer through the same wire. Two years later, his plan was so matured that he could telegraph to a distance, and receive replies; and he then exhibited it to hundreds of people in the University of New York, where soon after the first photograph of a human countenance was taken by Dr. J. W. Draper.

It is interesting to note the equality of the rhythms of mental movement in the development of electrical science. If we start with Du Fay, the greatest electrician of the last century, and who first introduced the conception of the two kinds of electricity, vitreous and resinous—afterward positive and negative—we may assume that he first laid its secure foundation as a science, and his researches were published in the proceedings of the French Academy in 1737. The next fifteen years was the most productive period in the development of frictional electricity, and ended with the invention of the lightning-rod in 1752. In 1790, a new form of electricity was discovered by Galvani, and then came a period of seventeen years in which the phenomena were rapidly developed, ending with Davy's grand experiments in electrical decomposition with the galvanic battery in 1807. In 1820, Oersted announced electro-magnetism, and then followed a brilliant course of discoveries again, for seventeen years, terminating in the patenting of the electro-magnetic telegraph by Morse in 1837—exactly a century from the publication of the memoirs of Du Fay.

It is not to be forgotten, however, that the time had come for the electric telegraph, and other men were working at the problem as well as Morse. He sailed for Europe in 1838, to get assistance in carrying out his project, and to obtain patents in foreign countries. In this he failed, because of rival contrivances already in the field. Cooke and Wheatstone in England, and Steinheil in Munich, had been at work for several years on the same problem. The latter had patented an electric telegraph in 1836, and the former in 1837.

Of Prof. Morse's difficulties in carrying out his great and beneficent invention, the lack of sympathy and appreciation on the part of the public, the faithlessness of capitalists, and the stupidity of the American Congress, little need be said, as it is but the old story over again. Yet he triumphed over all these obstacles, and lived to a ripe old age, to enjoy in munificent measure the rewards and the applause of his generation.

THE SCIENCE OF SOCIETY.

THE first article of our first number is the first instalment of a series of essays on the study of society in a methodical way, or sociology. But few

can now be found who will question that the author of these articles is the highest authority of our age upon the subject. To deal with any thing so vast and complex as society, by an original method, so as to bring out the natural laws of its constitution, requires rare powers and attainments on the part of him who undertakes it. He must have an accurate and extensive acquaintance with the higher sciences of life and mind, as well as the various states and phases of man's social condition. To encyclopædic knowledge, there must be added originality, independence, and a broad grasp of principles and details. That Mr. Spencer possesses these in an eminent degree, we are assured by authorities who are both competent to judge and cautious in the expression of their judgment—such men as Mill, Hooker, Lewes, Darwin, Morell, Wallace, Huxley, Masson, McCosh. In the last number of the *Contemporary Review* is an article by the acute essayist, "Henry Holbeach," referring to what Mr. Spencer has already written on public and social questions, in which he is spoken of as "holding the unique and very eminent place as a great thinker, which he does, in fact, hold," and these writings are referred to as containing "an arsenal of argument and illustration never surpassed for range and force, if ever equalled in the history of philosophy."

Mr. Spencer has now been engaged twelve years on his life-work, a system of Synthetic Philosophy, based on the doctrine of evolution. Five volumes of this work will be completed next autumn, in which the foundations are deeply laid in the sciences of life and mind for the third great discussion—the Principles of Sociology, in three volumes, treating of the development of society in all its elements in accordance with the theory of evolution.

Before entering upon this part of his undertaking, the author has thought it expedient to make some observations concerning it, which will be outside of the philosophical system, and independent of it. Those who have familiarized themselves with the former parts of his system, are not as the stars of heaven in number; nor are those who understand the nature and claims of sociological science as the sands of the sea. The term social science has indeed come into vogue, and large associations have assumed it; but, as thus applied, it fails to connote any distinctive or coherent body of principles such as are necessary to constitute a science.

In this state of things, and before proceeding to the systematic work of developing the science itself, Mr. Spencer will consider its claims as an object of study, its subject matter, its method of investigation, scope, and limits. The article which is now published presents the need of the study, and the next will answer the question, "Is there a social science?" The paper we now publish tells its own story, and the subsequent ones will not fall below it in interest and instructiveness.

LITERARY NOTICES.

INSTINCT: ITS OFFICE IN THE ANIMAL KINGDOM, AND ITS RELATION TO THE HIGHER POWERS IN MAN. By P. A. Chadbourne, LL. D. George P. Putnam & Sons.

THIS is a very interesting volume on a fascinating subject. Dr. Chadbourne is well known as an able student of natural history, which he has long cultivated both by independent observation and in a philosophic spirit, and in this little book he gives the results of much study of instinctive action as displayed in the lower animals, and of much reflection on its bearings upon the mental and moral nature of man. Conceding fully man's close relation to the forms of life below him, Dr. Chadbourne recognizes the scientific necessity of investigating the lower to get a true interpretation of the higher; or of tracing out the workings of instinctive impulse in the simpler creatures, in order to understand the springs of movement in our own more com-

plex mental nature. The volume is full of fresh and suggestive facts, and the author discusses the doctrines put forth by some of the recent biologists in the most liberal temper. Natural selection is recognized as a true principle of Nature, producing real effects; but it is held insufficient to account for much that is attributed to it. We cordially indorse his claim for greater breadth of culture as indispensable to a true understanding of the science of human nature: "It is with a deep conviction of the need of the hearty coöperation of the cultivators of different fields of science, especially of Naturalists and Mental Philosophers, in the full study of man, that these Lectures are presented to the public. Broad culture as a foundation for scientific attainments, respect for other sciences than our own, and intercourse with those who view the same subjects from other stand-points than our own, are absolutely essential for safe generalizations in those complex sciences that relate to animal and rational life."

THE TO-MORROW OF DEATH; OR, THE FUTURE LIFE ACCORDING TO SCIENCE. By Louis Figuier. Roberts Brothers.

IN this little book the great French compiler turns religious romancer, as he has a perfect right to do if it suits him. But the pretence that his childish vagaries are "according to science" is in the last degree absurd. A great deal of talk about science is mixed up with the most preposterous speculations concerning the supernatural, until the reader is puzzled to decide whether the writer is wag, fanatic, or fool. If honest, it is a case of emotion upsetting intellect. The author begins by propounding to the reader the safe induction that he must die. He then says that he lost a beloved son, and, falling into great grief, he at once began to speculate about the future life and the spiritual world, and came to the conclusions that light and heat are emanations of soul-substance; that some human souls migrate into the bodies of new-born children; and that the sun is the home of human souls after death. The book is not worth reading, and would not be worth mentioning, but that the writer has a sort of reputation which may mislead many as to the character of his performance.

A DICTIONARY OF ENGLISH ETYMOLOGY, by Hensleigh Wedgewood. Macmillan & Co.

THIS is a painstaking and exhaustive work on the derivation of English words from other languages, and the origin and history of their meanings. It has passed to a second edition, and the author has had the assistance of Mr. George P. Marsh in making its thorough revision. We took it up in utter innocence, supposing it to be sound and safe, and never for a moment dreaming of any thing wrong or dangerous between its honest-looking lids. But what was our astonishment to find that the pestilent doctrine of "Darwinism," that is thrusting itself into every place where it is not welcome, and taking away the peace of so many worthy people, had got in here also. Darwinism, rank and outright, in an arid etymological dictionary! It seems that the author could not escape it. Etymology opens the question of the origin of words and language. It goes back to beginnings, and is fundamentally concerned to know by what law or method language has been formed. As language is an attribute of man, it links itself at once to the question of the origin of man. Were man and language created perfect at first, and has their onward course been a movement of degeneracy; or did they begin low and imperfect, and has the movement been a gradual unfolding—an evolution? This is more than a mere speculative question; it involves the interpretation that shall be given to the facts before us. If man and language have come to be what they are through a principle of slow and gradual evolution, our mode of regarding them will be very different from that which must be adopted if they came by an opposite method. And so the author prefixes to the second edition of his volume an elaborate essay on the origin of language, in which he rejects the old and still current view, and declares for the doctrine of evolution. We extract a portion of his statement: "If man can anyhow have stumbled into speech under the guidance of his ordinary intelligence, it will be absurd to suppose that he was helped over the first steps of his progress by some supernatural go-cart, in the shape either of direct inspiration, or, what comes to the same thing, of an instinct unknown to us at

the present day, but lent for a while to Primitive Man in order to enable him to communicate with his fellows, and then withdrawn when its purpose was accomplished.

"Perhaps, after all, it will be found that the principal obstacle to belief in the rational origin of Language is an excusable repugnance to think of Man as having ever been in so brutish a condition of life as is implied in the want of speech. Imagination has always delighted to place the cradle of our race in a golden age of innocent enjoyment, and the more rational views of what the course of life must have been before the race had acquired the use of significant speech, or had elaborated for themselves the most necessary arts of subsistence, are felt by unreflecting piety as derogatory to the dignity of Man and the character of a beneficent Creator. But this is a dangerous line of thought, and the only safe rule in speculating on the possible dispensations of Providence (as has been well pointed out by Mr. Farrar) is the observation of the various conditions in which it is actually allotted to Man (without any choice of his own) to carry on his life. What is actually allowed to happen to any family of Man cannot be incompatible either with the goodness of God or with His views of the dignity of the human race. And God is no respecter of persons or of races. However hard or degrading the life of the Fuegian or the Bushman may appear to us, it can be no impeachment of the Divine love to suppose that our own progenitors were exposed to a similar struggle.

"We have only the choice of two alternatives. We must either suppose that Man was created in a civilized state, ready instructed in the arts necessary for the conduct of life, and was permitted to fall back into the degraded condition which we witness among savage tribes; or else, that he started from the lowest grade, and rose toward a higher state of being, by the accumulated acquisitions in arts and knowledge of generation after generation, and by the advantage constantly given to superior capacity in the struggle for life. Of these alternatives, that which embodies the notion of continued progress is most in accordance with all our experience of the general course of events, notwithstanding the apparent stagnation of particular races, and the barbarism and misery occasionally caused by violence and warfare. We have witnessed a notable advance in the conveniences of life in our own time, and, when we look back as far as history will reach, we find our ancestors in the condition of rude barbarians. Beyond the reach of any written records we have evidence that the country was inhabited by a race of hunters (whether our progenitors or not) who sheltered in caves, and carried on their warfare with the wild beasts with the rudest weapons of chipped flint. Whether the owners of these earliest relics of the human race were speaking men or not, who shall say? It is certain only that Language is not the innate inheritance of our race; that it must have begun to be acquired by some definite generation in the pedigree of Man; and as many intelligent and highly-social kinds of animals, as elephants, for instance, or beavers, live in harmony without the aid of this great convenience of social life, there is no apparent reason why our own race should not have led their life on earth for an indefinite period before they acquired the use of speech; whether before that epoch the progenitors of the race ought to be called by the name of Man or not.

"Geologists, however, universally look back to a period when the earth was peopled only by animal races, without a trace of human existence; and the mere absence of Man among an animal population of the world is felt by no one as repugnant to a thorough belief in the providential rule of the Creator. Why, then, should such a feeling be roused by the complementary theory which bridges over the interval to the appearance of Man, and supposes that one of the races of the purely animal period was gradually raised in the scale of intelligence, by the laws of variation affecting all procreative kinds of being, until the progeny, in the course of generations, attained to so enlarged an understanding as to become capable of appreciating each other's motives; of being moved to admiration and love by the exhibition of loving courage, or to indignation and hate by malignant conduct; of finding enjoyment or pain in the applause or reprobation of their fellows, or of their own reflected thoughts; and, sooner

or later, of using imitative signs for the purpose of bringing absent things to the thoughts of another mind?"

THE FIRST BOOK OF BOTANY. By Eliza A. Youmans. New edition. D. Appleton & Company.

A SCHOOL-BOOK which declares itself to be little else than a finger-board, pointing to something else to be studied, and which is designed to avoid lesson-learning and to break up school-routine, is certainly something unusual in the educational world, and we might suppose from all analogy that it would meet with little favor. Yet such are the character and object of the "First Book of Botany." It was prepared, not to enable the pupil to memorize a certain amount of information about the vegetable kingdom, but to put him in the way of training his observing powers by the actual, systematic study of plants themselves. It is a hand-book of guidance in the work of observation. It is an encouraging sign of improvement in methods of instruction that a book so thoroughly constructed on this plan should still not be a day ahead of the time. Its prompt and extensive adoption by the Boards of Education in many cities is an encouraging evidence of progress in the art of elementary teaching. The work has been reprinted in England, and is reviewed in the *Pall Mall Gazette* by Prof. Payne, of the College of Preceptors, under the title of "Botany as a Fourth Fundamental Branch of Study." He says:

"This book is so remarkably distinguished from the ordinary run of school-books that no apology is necessary for calling the attention, not only of teachers, but of all who are interested in education, to its pretensions and merits. Too many school-books, professedly compiled for the use of children, are really fit only to be hand-books for the teacher or the adult scientific student. Abounding with definitions and abstractions which presuppose a knowledge of the facts on which they are founded, they tend to quench rather than quicken the dawning intelligence of the child. These abstractions, though called *principia* or beginnings, are, in fact, such only to the mind already trained in deduction. Induction, on the other hand, appears to be the only possible method that a child can employ in gaining a real knowledge of principles. We may, of course—and we usually do—cram him with those intellectual boluses called definitions and rules, in the hope and belief that some time or other he will digest them; but we also very commonly—and here is the absurdity of our plan—leave this process of mental digestion to chance, instead of regarding it as the end to be secured by the training of the teacher. Thousands of children carry about with them this crude, undigested matter, throughout the whole of their school-life; and, if it is ever assimilated and appropriated by the mental system, it is after school-life is over, and the youth takes his education into his own hands and begins it anew. Holding, then, as we do, that the primary aim of all teaching should be the quickening of intellectual life in the pupil, and trying school-books generally by this test, we cannot but pronounce the great mass of them to be hinderances rather than helps to the object in view. They are hinderances and not helps, whenever they supersede the action of the pupil's own mind on the facts which they describe. In matters of science especially, the facts, the concrete things, are the true teachers, and should be allowed to impress their lessons by direct contact—without any foreign intervention—on the mind of the learner. These lessons gained by the authoritative teaching of facts will necessarily be productive of clear, definite, and permanent impressions, and must, therefore, be far more valuable than those given by the conventional bookmaker on his own authority. We go further, and maintain that the principle we have suggested furnishes a true test of the suitability of any given subject for elementary instruction, which, as we believe, should be confined in its earliest stages to those subjects in which the pupil can gain his knowledge at first hand from facts within his own cognizance. If, therefore, as has been declared by good authorities on the subject, that kind of teaching alone is effective which makes the pupil teach himself, it is obvious that elementary education should consist in eliciting the native powers of the child, and make him take an active share in the process by which knowledge is acquired; in setting him forth, in short, however young, on

the path of investigation. The implicit reception of truths gained by the observation and experiments of others is, as things are, often unavoidable in the case of the adult man, presumed to be already educated, but is antagonistic to educational training, which consists in the development and direction of the native intellectual forces of the child.

"This conception of the nature and power of education has been firmly grasped and exhibited with remarkable skill by the author of the little book now under notice, which is expressly designed to make the earliest instruction of children a mental discipline. Miss Youmans, of New York, presents in her work the ripe results of educational experience reduced to a system. Wisely conceiving that all education—even the most elementary—should be regarded as a discipline of the mental powers, and that the facts of external Nature supply the most suitable materials for this discipline in the case of children, she has applied that principle to the study of botany. This study, according to her just notions on the subject, is to be fundamentally based on the exercise of the pupil's own powers of observation. He is to see and examine the properties of plants and flowers at first hand, not merely to be informed of what others have seen and examined. His own observation, resulting in the perception for himself of form, color, interrelation of parts, likeness and unlikeness, etc., is to be the *primum mobile* of his whole course of learning. His own examination and investigation of phenomena, his own reasoning and judgment on discovered relations, are to constitute the process by which he learns not only the facts and phenomena of botany, but also the use of his mental faculties. Inasmuch, moreover, as the phenomena that he observes are coördinated in Nature, the process becomes one not only for acquiring separate facts but organized knowledge, and, therefore, a systematic training in the art of observation. 'This plan,' Miss Youmans remarks, 'first supplies the long-recognized deficiency of object-teaching by reducing it to a method, and connecting it with an established branch of school-study. Instead of desultory practice in noting the disconnected properties of casual objects, the exercises are made systematic, and the pupil is trained not only to observe the sensible facts, but constantly to put them in those relations of thought by which they become organized knowledge.' It is obvious that a course of instruction which secures such results as these, and which is applicable to the most elementary education, involving not merely the acquisition of sound knowledge, but the systematic training of the mind as a preparation for subsequent studies, literary as well as scientific, is a very valuable contribution to our educational resources. It supplies 'that exact and solid study of some portion of inductive knowledge' which is pointed out by Dr. Whewell (lecture 'On Intellectual Education,' delivered at the Royal Institution) as a want in education, and which would end in a real discipline for the mind by enabling it to 'escape from the thraldom and illusion which reign in the world of mere words.' 'The knowledge of which I speak,' he adds, 'must be a knowledge of things, and not merely of names of things; an acquaintance with the operations and productions of Nature, as they appear to the eye, not merely an acquaintance with what has been said about them; a knowledge of the laws of Nature, seen in special experiments and observations, before they are conceived in general terms; a knowledge of the types of natural forms gathered from individual cases already made familiar.'

"The desideratum here indicated is, we repeat, supplied for the first time by Miss Youmans's plan of teaching botany, which she accordingly proposes as a 'fourth fundamental branch of study, which shall afford a systematic training of the observing powers.' Some may of course question the pretensions of botany to the position here claimed; but it will be found more easy to object than to propose a substitute.

"It may, however, with better reason, be objected that the study of a descriptive science like botany, which is founded essentially on observation, fails to elicit the inventive and constructive faculties of the child, and to secure that training in the experimental knowledge of the action and reaction of forces, cause and effect, etc., which constitutes the method of scientific investigation. We should, therefore, suggest, as

equally, or almost equally, suitable for elementary instruction (see Edgeworth's 'Practical Education,' and 'Harry and Lucy'), a collateral or supplementary training, similar in spirit and plan to Miss Youmans's in experimental mechanics founded on the phenomena of mechanical action. Botany for observation, mechanics for experiment, would complete that foundation of nature and fact on which technical education, if it is to be a reality and not a pretence, must be ultimately based."

MISCELLANY.

THE NATURE OF DISEASE. BY SIR WM. W. GULL, BART., M. D., F. R. S.[1]

In addressing you this evening, gentlemen, I have in some sort to throw myself on the forbearance of the Society, for, though I have been able to bring certain ideas together on the subject on which I desire to speak, I have not, for want of time, been able to adopt a form of words such as I would have liked. In some sense I am the spokesman of the Society as its President, in especial when laying before the public the objects of the Society as I would now do.

We, in our calling, differ from some theologians in one important respect: they look on this world as a decaying world, as much worse than it once was; we, as students of Nature, are opposed to this view, for, if we look to the history of Nature, we see we are ever advancing toward perfection, even if we are not likely to reach it. This is an improving world, and we are met to advance that idea. We believe that this world has something better in store for all than any thing which has yet been seen, and are like to the convalescent, whose last day should always be the very best he has ever spent. Some men are apt to think that science has certain limits set to it, beyond which no man may go; but we believe that knowledge extends far beyond the strictly scientific limit. Doubtless, were the early lower animals assembled together in conclave, they would conceive it quite impossible to transcend their status; that when the world came to megatheriums, let us say, then it must stop. They could not conceive the possibility of such a being as man. But at this point we join the theologians again in accepting a metaphysical element, in forming conceptions of things of which we can have no positive knowledge. In this way we may be said to worship Nature, but only in a very limited sense. We look upon our being, not as perfect, but as becoming perfect, and we are here to-night —and at all times have it as our object—to improve these defects of Nature, and to endeavor to perfect the human frame.

Respecting the object we work for—this living organism of ours—one great advance has of late been made. We are acquiring a physiological notion of disease. Disease is no entity; it is but a modification of health—a perverted physiological process; and this must at all times be insisted upon. Were it not that we fear death, and dislike pain, we should not look upon disease as any thing abnormal in the life-process, but to be as part and parcel of it. Few would now venture on a definition of disease; for in reality it is but the course of Nature in a living thing which is not health. In health the balance of function is even; incline it to either side, and there is disease. That being so, just as the life-process constitutes an individual and puts him apart from his fellows, so must any alteration in it be individual, and not general. But to the ignorant disease is an entity—an evil spirit which attacks us and seizes us. Hence arises the word "seizure," which, though in a somewhat different way, we still use, but with a protest. To the charlatan, disease is a set of symptoms to be attacked by a variety of drugs—a drug for each symptom. To us, disease is a life-process of a perverted kind.

Many states are not now called diseases which used to be, and there are still some to be expunged. Some people are always ailing. Some have feeble stability, and to them it is as natural to be ill as it is to others to be well; but this is not disease. So, too, aged persons get ill; but this is not disease—in reality, it is natural change simulating disease, and, when we try to cure such, we use all the farrago of the chemist's shop to prevent the sun setting. So syphi

[1] Remarks before the Clinical Society of London.

lis at last ceases in the system to be syphilis, and becomes an early decay.

It is curious to consider the various morbific agents at work within our bodies, the lines in which they work, and their seats of action. These as yet have been but little studied, and deserve attention. Thus, it is very doubtful if scarlatina begins in the blood, as we should all be apt to say, rather than in any other tissue or fluid. Let it be our object to find out where all these begin within the body, and how they enter the body. In future, I hope, comparative pathology, which is just beginning to be studied, will teach us much; for in our bodies we men have many organs which are of little or no use to us, and are only relics of a former state of being. What, for instance, is the comparative anatomy of tonsils? Were I to make a man, I do not think I would put tonsils in him. Yet these, and such like organs, in accordance with the general law, are more prone to disease than are the others which are of real use in the system. I remember the case of a man who had a permanent vitelline duct. He had been out on a cold day, and the motion of the intestines twisted them in a mass round this persistent duct, and he died. I made a preparation of the duct, and wrote under it, "Cui vitam atque mortem dedit diverticulum." Every part of the body is alive, and has its own individual life and pathology, whether it be immediately required or not; only, if not required, it is more prone to disease than if it were. I could, for instance, suppose a fœtus of four months going to the doctor and saying: "I am going all wrong; my Wolffian bodies are disappearing, and kidneys are coming in their stead." Yet that is as much a condition of disease as some of those conditions of which I speak.

It is of the utmost possible importance, then, to be able to tell what we have and what we have not to cure. How often do we find people trying to do what is impossible! Some women have no more vital capacity than a canary-bird; they are constantly ill, and it is useless to attempt to make them well. A man came to me, and said: "I don't know what to do with So-and-so. I have given her every thing I could think of, and she will not get strong." "Why," I said, "you have been trying to put a quart into a pint pot. You cannot make her strong, and never will."

So, when a new instrument or mechanical means of diagnosis is introduced, we must try to make ourselves masters of it, so as to be able to use it aright, even though this is troublesome to ourselves; only we must beware of applying the knowledge thus acquired too early to practice. Thus, as regards the thermometer, doubtless it yields us most valuable information, but we must beware of using it as a guide to our treatment until we have a more complete knowledge of the condition of bodily temperature.

But after the physical comes the vital diagnosis. It is well to know exactly what is the condition of each part of the system; but to what is the wrong due? That no weighing or measuring can give you—only experience. A man has pneumonia—that is a too vague fact; what are the dynamics of the disease? One man with a pneumonia will get rapidly well and be right again in a few days, whereas another man will not get well at all. So, in different individuals, a form of disease apparently the same may be different from the beginning, and this we cannot always make out in our diagnosis, especially in internal disease. In skin-diseases we can do better.

During the last week I had been called on, as most of you know, to form a diagnosis of the workings of the mind. Here the break-down may be the first sign of the diseased condition, just as it may be in heart-disease, peritonitis, and a score of other diseases. A man, after racing up a hill, finds himself breathless and spitting blood. He comes to you, and you find heart-disease. It does not mean that the heart-disease was produced by running up the hill; it only means that an organ, equal to its ordinary duties, failed when unusual stress came to be laid upon it. So is peritonitis often the result of disease previously latent, but brought on by exposure to cold, or some such agency. Some men say that such cases as those of doubtful sanity should not be taken up by us—that ordinary men are quite as well fitted for finding out the truth as we are, with all our training. If so, all I say is, that it is no honor to us that it is so.

Now, therapeutics is the end, though the study of diseased conditions might be pleasant enough by itself. We are sometimes twitted with letting Nature alone to do her work. We do not. And here, again, we join issue with the theologians. They say, "If it is God's will that a man die, so be it." But, say we, "God's will is to be found out; it is not a mere fate." We are not ignorant worshippers of Nature, and, whether a man is doomed to die or no, we know only by the result. We are connective agents. We have to adjust and correct. We know the tendency to recurrence to the equilibrium—that is, health—and we endeavor to assist in adjusting this balance in each individual.

In fever, for instance, two things are promptly at work—destructive changes, and changes tending to recovery. In such diseases there are certain superficial accidents which we are apt to notice. In fever there are often complications; but these are really part of the fever-process, and are not to be interfered with by themselves. Our study must be, how best to bring the condition to a safe ending; for a patient in fever may get well of the fever, and yet die of a bedsore.

In conclusion, if I have spoken more as regards medicine than as regards surgery, I think the surgeons ought to be indebted to me for hints toward the extirpation of superfluous organs—a grand prospect for the surgeons of the future.—*British Medical Journal.*

SOUTHERN ALASKA.

THE following statements are from a paper entitled "Medical Notes on Alaska," by W. T. WYTHE, M. D., read before the Sacramento Society for Medical Improvement, and published in the *Pacific Medical Journal:*

The country is very mountainous; lofty peaks, clad with snow throughout the year, being everywhere visible. One mountain-chain, identical with the Sierra Nevada and Coast Range of California, extends along the coast, through the Alaskan Peninsula and the Aleutian Islands; another chain, the continuation of the Rocky Mountain system, extends across the country to Behring's Strait, and, passing under the sea, is said to reappear in Asia. Between these two mountain-chains lies an immense valley, drained by the Youkon, a river nearly as large as the Mississippi, and which Dr. Dall has well described in his work on Alaska. These mountains, with their numerous branching chains and foot-hills, cover the whole country with impassable barriers. Among them lie many valleys, where, during the few days of summer, some vegetation can be seen, and it is here that the natives live; sometimes, however, a glacier will encroach upon the valley, or an avalanche of snow and rocks from the neighboring hills fill it up, or in spring a flood overflow it. In these inhabitable spots there is but little soil; all the vegetation seems to spring up in the peat-bogs, which are found everywhere except on the mountains. In these bogs, when sheltered from the winds, many kinds of trees will grow, but they are almost totally worthless. Grass grows very rapidly during the warmer days of summer, and sometimes attains a height of five feet. For agricultural purposes the territory is worthless.

The climate of the interior of Alaska is very different from that of the coast. Along the coast the average temperature is about 40° Fahr. during the year, while on the other side of the mountains it is many degrees lower. The coast is very foggy and damp. The rainfalls are very frequent, and it is subject to very severe storms of wind. At Sitka, it is said that for a number of years past the number of days during the year, when it did not rain or snow, has been thirty-five. In the interior the climate is very cold in winter, and in summer somewhat warmer than on the coast. There is but little rain or fog. Snow falls to a great depth, and I have seen the ground frozen thirteen inches below the surface in midsummer. The cause of this peculiar climate, and of the difference of average temperature on the coast and the interior, is the same that modifies the whole Pacific coast. The Japan current, which brings the warm waters of the southeast shores of Asia, is undoubtedly the principal agent in controlling the climate of the northwest coast of America. From the Aleutian Islands to Sitka the whole coast is bathed by this "Pacific Gulf Stream." In addition to this current, the winds have a share in influencing the climate. Along the coast the prevailing winds are from the